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# ENVIRONMENTAL ASSESSMENT BOARD



## ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARINGS

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VOLUME: 129

DATE: Tuesday, April 7, 1992

BEFORE:


|                              |          |
|------------------------------|----------|
| HON. MR. JUSTICE E. SAUNDERS | Chairman |
| DR. G. CONNELL               | Member   |
| MS. G. PATTERSON             | Member   |

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ENVIRONMENTAL ASSESSMENT BOARD  
ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARING

IN THE MATTER OF the Environmental Assessment Act,  
R.S.O. 1980, c. 140, as amended, and Regulations  
thereunder;

AND IN THE MATTER OF an undertaking by Ontario Hydro  
consisting of a program in respect of activities  
associated with meeting future electricity  
requirements in Ontario.

Held on the 5th Floor, 2200  
Yonge Street, Toronto, Ontario,  
Tuesday, the 7th day of April,  
1992, commencing at 10:00 a.m.

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VOLUME 129  
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B E F O R E :

|                                  |          |
|----------------------------------|----------|
| THE HON. MR. JUSTICE E. SAUNDERS | Chairman |
| DR. G. CONNELL                   | Member   |
| MS. G. PATTERSON                 | Member   |

S T A F F :

|                 |   |
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1       ---Upon commencing at 10:00 a.m.

2                   THE REGISTRAR: Please come to order.

3       This hearing is now in session. Please be seated.

4                   THE CHAIRMAN: Mr. Campbell?

5                   MR. B. CAMPBELL: Mr. Chairman, Dr.

6       Whillans has advised me that he has had an opportunity  
7       to make some inquiries about these rates per 100,000,  
8       the mortality tables.

9                   You will recall a discussion yesterday  
10       where there was some confusion about whether the  
11       figures, male and female, were per 100,000 such that  
12       you had to add them together, and so on. I think he  
13       wants to add to the confusion on this matter.

14                   DAVID WHILLANS,  
15                   KURT JOHANSEN,  
16                   FRANK CALVIN KING,  
                  WILLIAM JOHN PENN,  
                  IAN NICHOL DALY; Resumed.

17       CROSS-EXAMINATION BY MR. BULLOCK (Cont'd):

18                   Q. I believe it was Exhibit 575, was it  
19       not, Dr. Whillans?

20                   DR. WHILLANS: A. We both have 574, but  
21       I could easily have been mistaken.

22                   Q. I could be wrong.

23                   A. It was the paper by Myers and Werner?

24                   Q. Yes.

25                   A. 574? Well, what I wanted to add was

1 simply that I have the Canadian cancer statistics  
2 published by the National Cancer Institute for 1991  
3 actually, and in that year there were 56,700 cancer  
4 deaths in Canada for a population estimated as  
5 26,000,807. So that is slightly over 200 cancer deaths  
6 per year per 100,000 population.

7 And so with respect to the estimate you  
8 were making for a population of 3 million that would be  
9 something like 6,000, and the 200 is neither the 295  
10 which we got by adding the columns in the table, nor  
11 half that value, and the reason has to do with this  
12 standardization process, that it is standardized to a  
13 world population which has a very different age  
14 distribution.

15 But the gross numbers are about 200 per  
16 100,000.

17 Q. All right. Well, that's very  
18 helpful. Thank you.

19 THE CHAIRMAN: I haven't got it in front  
20 of me, but there were two columns, one male and one  
21 female, as I remember.

22 DR. WHILLANS: That's right.

23 THE CHAIRMAN: And it was per 100,000.  
24 Was that --

25 DR. WHILLANS: That's correct.

1 THE CHAIRMAN: And the argument was  
2 whether it was 100,000 for each column or 100,000 in  
3 gross.

4 DR. WHILLANS: I think the proper way to  
5 do it is 100,000 for each column, but that would give  
6 you only about a 150, and this is higher than that  
7 because, as I say, of the age distribution.

8 MR. BULLOCK: Q. In other words, it is a  
9 very difficult table to work with is what you are  
10 suggesting?

11 DR. WHILLANS: A. I think statisticians  
12 are comfortable because they always work to these  
13 standardized populations, but when you try to multiply  
14 those numbers through by populations you don't get  
15 number of cases that you expect. That's the reason.

16 Q. Sure. And perhaps, Mr. Chairman, to  
17 assist with the reference I have been through the  
18 transcript from yesterday, and perhaps, Dr. Whillans,  
19 if you have Volume 128 -- do you have it available?  
20 Just so we have some references, Mr. Chairman.

21 Dr. Whillans, perhaps I could take you to  
22 Volume 128, yesterday's transcript, to page 22513.

23 A. I have it.

24 Q. Line 5.

25 A. Yes?

1 Q. You were talking about comparing the  
2 .088 induced cancers per annum figure with the expected  
3 cancer deaths per year. That is what you are talking  
4 about in that paragraph, are you not?

5 A. Yes.

6 Q. So what you are suggesting is that  
7 that should really read now 50 times 6,000; isn't that  
8 right?

9 A. That is right.

10 Q. Okay. And just to do the arithmetic,  
11 then, I think the expected life of a nuclear facility  
12 is 40 years; isn't that right?

13 A. That is the planned life, yes.

14 Q. And if we take the planned life then  
15 of 40 years can we just multiply that by .088? Would  
16 that be the way that we would find the total?

17 A. That would be a gross estimate. I  
18 don't think it is probably very meaningful because  
19 situations can easily change over a 40-year lifetime.

20 What we are doing I think in this  
21 exercise is estimating for a particular year of  
22 operation, which is typical of 1990 or recent years,  
23 how many induced cancers we believe may have been  
24 caused in comparison with how many would be in that  
25 population normally.



1 Q. Right.

2 A. But to extend it over 40 years, I  
3 think, is really getting rather speculative.

4 Q. That's fine. We will leave it there.  
5 That is the reference, Mr. Chairman, to correct that  
6 number.

7 A. May I also make a comment on  
8 something that Dr. Connell asked yesterday?

9 We were having a discussion about the  
10 risk of sitting next to someone because of the K40, and  
11 I did look into it. The dose from K40 is given by two  
12 mechanisms. It is a beta emitter and also a gamma  
13 emitter.

14 The beta has a fairly short range, a  
15 fraction of a centimetre, so the beta emissions from  
16 Mr. Johansen would not be largely leaving the body, and  
17 that actually accounts for about 90 per cent of the  
18 internal dose, and the other 10 per cent or about .01  
19 millisieverts is due to the gamma. So I would be  
20 suffering some fraction of that as a risk, and it is  
21 quite a small number.

22 DR. CONNELL: Thank you.

23 MR. BULLOCK: I expect to be no more, Mr.  
24 Chairman, than about 10 minutes this morning.

25 Q. Mr. King, I have a couple of

1 questions about the unavailability criteria, and  
2 perhaps the place to start would be Volume 122 at the  
3 bottom of page 21291. Volume 122, at the bottom of  
4 page 21291, do you have it, sir?

5 MR. KING: A. Yes, I do.

6 Q. And, Mr. King, in the paragraph  
7 starting "In many cases...", and perhaps I can just  
8 read it so we have it for reference for those that  
9 don't have their transcripts here:

10 In many cases, as I have discussed,  
11 the system performance would only be  
12 degraded somewhat and substantial  
13 mitigative capability would still be  
14 available. Also, a special safety system  
15 is declared unavailable if it can't meet  
16 its designed performance requirements for  
17 all postulated accidents.

18 If it could meet its design  
19 requirements for all but the most  
20 unlikely and demanding postulated  
21 accidents it would still be declared  
22 fully unavailable.

23 And just a correction. Should that line "if it could  
24 meet", should that be "if it could not meet", "if it  
25 could not meet its design requirements for all" then it

1 would still be declared?

2 Or how would that read? I was just  
3 confused by that last sentence.

4 A. It should read: If it could meet its  
5 design requirements for all but the most unlikely and  
6 demanding postulated accident. Should have been  
7 singular.

8 Q. Oh, I see. So in other words, in  
9 again my layman's language, Mr. King, I take it, then,  
10 that if the safety system can't meet its design specs  
11 perfectly then it is declared unavailable; is that  
12 right?

13 A. That is generally right, yes.

14 Q. And two points, then. First of all,  
15 would it be fair to say that the design specifications  
16 for a nuclear unit would build in considerable extra  
17 safety margins? Would that be a fair statement when  
18 talking about design specs?

19 A. It is the credit that you take in  
20 your safety analysis which would generally reflect the  
21 design specifications, but if the credit that you take  
22 in your safety analysis as reported in the safety  
23 report, if you exceed those values then you would  
24 declare it unavailable, and in many cases those credits  
25 that you would take in the safety analysis would be

1 conservative.

2 Q. All right. I am dealing then with  
3 the design specifications, and I believe you gave an  
4 example something like this in your evidence in chief.

5 If a seal needed to be able to withstand  
6 something of the order of 14 kiloPascals of pressure -  
7 I think that is the right unit - it would, I take it,  
8 be designed to withstand something considerably more  
9 than that pressure; would that be fair?

10 A. What you are referring to is a  
11 description I gave in my evidence in chief where I was  
12 referring to the case where a loss of coolant accident,  
13 the largest loss of coolant accident at Pickering,  
14 would have a peak pressure of 14 kiloPascals gauge, and  
15 the particular seal that you are referring to had a  
16 design pressure of 21 kiloPascals gauge, but the design  
17 pressure was set by a different accident - not the loss  
18 of coolant accident; it was set by a failure of the  
19 main steam main.

20 But you are generally correct in saying  
21 that design pressure would normally envelope all the  
22 possible accident pressures and it would be higher than  
23 the accident pressures from whatever accident.

24 As well, in testing you would test  
25 components over the design pressure. In pressure-

1 retaining components like this, it is typically -- I  
2 believe the code calls for a test pressure of 1.15  
3 above the design pressure.

4 Q. That would be 1-point...

5 A. One-five.

6 Q. Times the design pressure?

7 A. Design pressure.

8 Q. Okay. And then talking about the  
9 function because you mentioned that just because it had  
10 been declared unavailable would not necessarily mean  
11 that it wouldn't function in at least some substantial  
12 mitigative capability, again in layman's language would  
13 it be fair to say then that just because a system has  
14 been declared unavailable does not necessarily mean  
15 that it will not function when it is called upon to do  
16 so?

17 A. As I said in my evidence, in many  
18 cases that is the case, especially when you are talking  
19 about containment.

20 [10:15 a.m.]

21 But you have to look at each case,  
22 case-by-case, to make a specific conclusion on that  
23 point.

24 Q. All right. Would you agree though  
25 that when you are talking about unavailability data,



1 you have to be very careful to understand exactly what  
2 is meant by the definition of unavailable and how that  
3 criteria is applied, because otherwise the information  
4 might be somewhat misleading perhaps to a member of the  
5 public that's looking at that data; would that be fair?  
6 You have to understand the technical definitions?

7 A. I think that's a fair statement.

8 Q. Thank you, Mr. King.

9 Just to wrap up then, Mr. Penn, I had  
10 taken to you tab 99 of the interrogatories brief, which  
11 is interrogatory -- there are two numbers, 8.44.1 and  
12 10.44.8, and there are two numbers because I believe  
13 the 8.44.1 number was a typographical error when the  
14 material was provided, it referred to the 10.44.8  
15 number. It's found at tab 99 at the brief.

16 Perhaps we could have and in number for  
17 that, Mr. Lucas.

18 THE REGISTRAR: 10.44.8 will be .59.

19 MR. BULLOCK: So that will 520.59, sir?

20 THE REGISTRAR: 520.59, yes.

21 ---EXHIBIT NO. 520.59: Interrogatory No. 10.44.8.

22 MR. BULLOCK: Q. And the interrogatory  
23 posed, Mr. Penn -- and we really need, Mr. Chairman, to  
24 have Exhibit 3 in front of us to understand the  
25 question.



1                   Exhibit 3, page 14-20. Do you have

2                   Exhibit 3 as well, Mr. Penn?

3                   MR. PENN: A. Yes, I do.

4                   Q. Sir, if we look then starting with  
5                   Exhibit 14-15 but going through the following exhibits  
6                   all the way over to figure 14-19 at page 14-26, we see  
7                   under the socio-economics heading, generally I think it  
8                   is the last, or second to last bullet, we see, for  
9                   instance, on page 14-20 about 45 per cent of lifecycle  
10                  cost is spent in Ontario at 80 per cent ACF.

11                  What the question was, what the  
12                  interrogatory question was, was rather than providing a  
13                  comparison of percentages of lifecycle costs, provide a  
14                  comparison between the various options in an absolute  
15                  dollar amount, and that was what was provided in the  
16                  answer to this interrogatory.

17                  Mr. Penn, I note that the date of the  
18                  answer to the interrogatory is 91/10/30, so October  
19                  30th of 1991. Are you able, sir, to confirm that the  
20                  information in the interrogatory answer remains  
21                  accurate today?

22                  A. Well, neither I nor my group were  
23                  responsible for calculating these numbers. But I do  
24                  note that option 11, which is a 4 by 881 megawatt CANDU  
25                  station and has a dollars of the year spent in-service

1 of 2002 of 21 billion, is a number I do recall.

2 Q. All right, sir.

3 A. But I can't honestly vouch for the  
4 accuracy of the other numbers without having them  
5 checked.

6 MR. BULLOCK: Perhaps, Mr. Chairman, I  
7 could speak to my friend Mr. Campbell about getting  
8 those numbers updated before we start Panel 10, because  
9 I think it goes to the socio-economic questions.

10 Would that be all right, Mr. Campbell?

11 MR. B. CAMPBELL: I am not certain  
12 whether these numbers may not have been updated  
13 already. There is a process going on of updating  
14 various figures in Exhibit 3 and there have been  
15 packages coming out regularly. This may have been done  
16 already. I think it is fair to say --

17 THE CHAIRMAN: This is not the  
18 presentation that's made in Exhibit 3, though. I don't  
19 think this presentation has been made in Exhibit 3.

20 MR. B. CAMPBELL: This is the set of  
21 numbers that are associated with the percentages that  
22 are in Exhibit 3.

23 THE CHAIRMAN: Yes.

24 MR. B. CAMPBELL: I believe my friend can  
25 assume that these are correct. They are correct for

1 Exhibit 3 and all I don't know is whether they have  
2 been part of the process of updating figures to the  
3 preferred plan in Exhibit 452, and I will have to check  
4 that. But if my friend would speak to me about that,  
5 we can take care of it.

6 MR. BULLOCK: The point is, Mr. Chairman,  
7 I just want to make sure that we have up-to-date data  
8 for the Board to rely on with respect to this question  
9 of socio-economic impacts and lifecycle costs being  
10 spent in Ontario. I can certainly speak to Mr.  
11 Campbell and we can work that out and deal with further  
12 in Panel 10 had.

13 With that sir, that's the conclusion.  
14 Thank you very much, gentlemen.

15 THE CHAIRMAN: Thank you, Mr. Bullock.

16 Mr. Poch?

17 MR. D. POCH: Thank you, Mr. Chairman. I  
18 will just be a minute, Mr. Chairman.

19 THE CHAIRMAN: Take your time.

20 MR. D. POCH: Mr. Chairman, I have handed  
21 to Mr. Lucas two volumes of materials which are  
22 compilations of various extracts, exhibits and  
23 interrogatories that I will be referring to in my  
24 cross.

25 Perhaps the volumes themselves should be

1 given an exhibit number for ease of reference.

2 THE CHAIRMAN: If they are a mixture,  
3 perhaps that would be convenient. But if we get to  
4 individual extracts perhaps we should label them in  
5 some way so they are easily identifiable.

6 MR. D. POCH: They are of course both.

7 THE REGISTRAR: Exhibit numbers for Panel  
8 9?

9 THE CHAIRMAN: I think the volumes  
10 themselves should be marked as exhibits.

11 THE REGISTRAR: Panel 9?

12 MR. D. POCH: Background Materials for  
13 CEG Cross-Examination of Ontario Hydro Witness Panel 9.

14 THE REGISTRAR: That will be 577.

15 MR. D. POCH: And then Volume 2 of that  
16 series.

17 THE REGISTRAR: Volume 2 will be 588

18 ---EXHIBIT NO. 577: Background Materials for CEG  
19 Cross-Examination of Ontario Hydro  
Witness Panel 9, Volume 1.

20 ---EXHIBIT NO. 578: Background Materials for CEG  
21 Cross-Examination of Ontario Hydro  
Witness Panel 9, Volume 2.

22 MR. D. POCH: Mr. Chairman, there may be  
23 one or two loose pieces of information which I will  
24 perhaps have brought before you as we reach them,  
25 to avoid confusion.

1        CROSS-EXAMINATION BY MR. D. POCH:

2                    Q.   Gentlemen, if you would be kind  
3        enough to turn in the first volume of our materials,  
4        577, to page 141.   I'm sorry, Volume 2 of our  
5        materials.   I am off to a good start.

6                    I have a preliminary version, so I hope  
7        the page numbers I have are the same as yours.

8                    What you have in front of you is  
9        Interrogatory 9.7.166.

10                   THE REGISTRAR:   9.7.166 will be .60.

11                   THE CHAIRMAN:   Thank you.

12        ---EXHIBIT NO. 520.60: Interrogatory No. 9.7.166.

13        [10:25 a.m.]

14                   MR. D. POCH:   Q.   First of all, Mr. Penn,  
15        would this be your answer or would you be responsible  
16        for this answer?

17                   MR. PENN:   A.   I didn't write this  
18        answer, but I agree with what it says.

19                   Q.   All right.   And here we asked you for  
20        capital costs for a different configuration of units,  
21        and I take it that that is not something you had  
22        studied in detail at the time of this interrogatory?

23                   A.   That is correct.   We hadn't studied  
24        it in detail no,

25                   Q.   And if we turn to the next page,



1 9.7.167?

2 THE REGISTRAR: That will be .61.

3 ---EXHIBIT NO. 520.61: Interrogatory No. 9.7.167.

4 MR. D. POCH: Q. Similarly, it is not  
5 something you studied in detail for future nuclear  
6 options as of April of last year? Well, actually you  
7 refer us to 166, so we can perhaps skip ahead to that.

8 MR. PENN: A. That is correct.

9 Q. Get back to that. And overleaf,  
10 9.7.168?

11 THE REGISTRAR: .62.

12 ---EXHIBIT NO. 520.62: Interrogatory No. 9.7.168.

13 MR. D. POCH: Q. You were unable to  
14 provide any kind of scaling factor for changing the  
15 capability or the rating of the units as of November?  
16 And that is still true, I take it. You have not done  
17 comprehensive studies, I take it, in the last few  
18 months of this factor?

19 MR. PENN: A. No, we haven't.

20 Q. And further, 9.7.169?

21 THE REGISTRAR: That will be .63.

22 ---EXHIBIT NO. 520.63: Interrogatory No. 9.7.169.

23 MR. D. POCH: Q. Here we asked about  
24 OM&A costs --

25 THE CHAIRMAN: I take it that scaling



1 factor means changes in per kilowatt costs as a  
2 function of changes in the megawatt capability of each  
3 unit; is that what the scaling factor is?

4 MR. D. POCH: Yes, that is what the  
5 question was intended to get, Mr. Chairman.

6 Q. Mr. Penn, can you confirm that is how  
7 you understood it?

8 MR. PENN: A. I think before I answer  
9 that question I would like to go back to the meaning of  
10 Exhibit 520.60 and look at the question.

11 What it in essence says is: Please  
12 indicate the savings in capital costs that Hydro  
13 believes it has obtained at each of Pickering "A",  
14 Bruce "A", Pickering "B" and Bruce "B" and Darlington  
15 for building four-unit generator stations, which we  
16 have done, as opposed to hypothetically building a  
17 twin, two-unit generating station at the same site but  
18 with no shared facilities.

19 Now, it doesn't say in the question what  
20 generating station we are talking about or what design.  
21 All it implies is that they are standalone units.

22 The second question is the similar sort  
23 of thing but on two separate sites.

24 The third question is four units of an  
25 undefined generating station at the same site but all

1 separate, having no shared facilities.

2 And the last question is the same as  
3 question 3, except that all four single units are all  
4 on four different sites.

5 Now, my answers have been "no", and the  
6 answers to these interrogatories that go right through  
7 to Interrogatory 9.7.170 are similarly "no", we haven't  
8 done that. But, of course, in the Preliminary Nuclear  
9 Option Review we did look at specific designs and  
10 different combinations of them at existing and new  
11 sites, and we did look at single units and four units.

12 Q. Yes, Mr. Penn. I appreciate that --

13 A. And we did produce scaling factors in  
14 that study.

15 Q. And we will come to that, of course.  
16 I was just trying to get on the record that in each of  
17 these cases at various times through 1991 as at that  
18 time you had not done comprehensive studies, and now we  
19 will come to your work in recent months; is that fair,  
20 then?

21 A. That is fair.

22 Q. And perhaps we can just quickly  
23 confirm, then, that as evidenced by 9.7.170--

24 THE REGISTRAR: .64.

25 ---EXHIBIT NO. 520.64: Interrogatory No. 9.7.170.

1 MR. D. POCH: Q. --you had similarly not  
2 looked at expectations of OM&A costs for different  
3 configurations: standalone, new site, old site, and so  
4 on?

5 THE CHAIRMAN: Just a moment. I'm sorry  
6 to interrupt, but we are skipping a number. .63 is the  
7 next number, is it not?

8 MR. D. POCH: .63 I think was assigned,  
9 Mr. Chairman, to 9.7.169, yes.

10 THE CHAIRMAN: We already put that in? I  
11 didn't remember that. Thank you.

12 THE REGISTRAR: .64 is 9.7.170.

13 THE CHAIRMAN: All right.

14 MR. D. POCH: Q. Mr. Penn, I take it  
15 that was the case last year?

16 MR. PENN: A. It was, yes, with respect  
17 to these alternatives that the question poses.

18 Q. Right.

19 A. The answer notes of course the  
20 benefits of OM&A, for example, of a standardized  
21 multi-unit CANDU station were discussed in ONCI.

22 Q. Yes, and that is the answer at .63?

23 A. That is correct.

24 Q. And similarly, at 9.7.171 you  
25 indicate that you haven't made a comprehensive study

1 with respect to capital modifications costs for  
2 different configurations or sitings, but you do believe  
3 that multi-unit stations have lower capital  
4 modifications costs?

5 A. Yes, on the basis that all units are  
6 the same--

7 Q. All right.

8 A. --in a multi-unit station--

9 Q. Yes.

10 A. --and therefore, once you have  
11 engineered the capital modifications for one you have  
12 done it for all four.

13 THE REGISTRAR: 9.7.171 is .65.

14 THE CHAIRMAN: Thank you.

15 ---EXHIBIT NO. 520.65: Interrogatory No. 9.7.171.

16 MR. D. POCH: Q. And just to complete  
17 the record on this point, 9.7.172 repeats that answer  
18 with respect to future stations?

19 THE REGISTRAR: 9.7.172 is .66.

20 ---EXHIBIT NO. 520.66: Interrogatory No. 9.7.172.

21 MR. PENN: That's correct. And again,  
22 noting that the reply was in the 5th of June, 1991.

23 MR. D. POCH: Q. And more generally with  
24 respect to cost of future stations at 9.7.173--

25 THE REGISTRAR: That is .67.

1       ---EXHIBIT NO. 520.67: Interrogatory No. 9.7.173.

2                   MR. D. POCH: Q. --in February of this  
3       year you referred us to 9.7.171, so that was still true  
4       at that time; no comprehensive study of this has been  
5       performed. And I take it that is still the case today?

6                   MR. PENN: A. Would you mind directing  
7       me to what question 520.67 refers to? It says here:  
8       List 9, question 676, and I don't know which question  
9       to look at.

10                  Q. The preceding question would be list  
11       9, question 675, which was assigned 9.7.172 and is  
12       Exhibit 520.66.

13                  A. That is on the previous page,  
14       one-point --

15                  Q. Yes, the previous question was  
16       narrowed to capital additions specifically, and then  
17       the second question, it refers to costs, expectations  
18       of costs.

19                  Mr. Penn, really the point here, the more  
20       general point is that the question of cost variations  
21       between different configurations is not something that  
22       has been comprehensively studied?

23                  A. No. But, as you know, we have done a  
24       preliminary review of other nuclear options.

25                  Q. Yes, all right.



1                   A. And that is why I guess I am a little  
2                   hesitant in answering these questions.

3                   First of all, the original question  
4                   wasn't specific to any design, and it certainly covered  
5                   different combinations than eventually we did look at.

6                   Q. Mr. Penn, now, going back to that  
7                   first question we were obviously talking about in  
8                   context of 4 by 881s at the time, and we were looking  
9                   to see if there was a difference if you built them one  
10                  up or if you built them on new sites, that sort of  
11                  variation, or two up, which you have not put forward as  
12                  a current consideration.

13                  A. Well --

14                  Q. Did you not understand the question  
15                  to imply that we were talking about that?

16                  A. Well, not really, because a  
17                  multi-unit station of course can't be built without  
18                  shared facilities. Now, maybe I am getting confused  
19                  with the question, but that is how I read it.

20                  Q. Well, when we asked you about capital  
21                  cost that you obtained -- savings you would have  
22                  obtained or you did obtain at these various stations,  
23                  four-unit stations as listed, compared to doing them  
24                  four single-unit generating stations, for example,  
25                  would you not -- well, whether you understood it at the



1 time or not, let's just get an update.

2 Would you agree that, say, building four  
3 Darlington-type but standalone, so obviously they don't  
4 have shared facilities, shared control room, shared  
5 vacuum building - I don't know; you tell me what else -  
6 that is not something that you have done the kind of  
7 detailed, comprehensive analysis of that you did of  
8 your costing of the 4 by 881 four-unit stations?

9 A. No, we haven't done it because in a  
10 multi-unit station, as I am sure you know, there are,  
11 for example, shared containment, there is shared  
12 fueling. So it is impossible to build them unless you  
13 build them in terms of, shall we say, a CANDU 9, which  
14 is a standalone design. You can't build a hydro design  
15 without shared facilities.

16 Q. All right.

17 A. It is fundamental.

18 Q. Let's look, then, at your -- well,  
19 first of all, let me ask. You have since provided us  
20 with some preliminary review of these different kinds  
21 of reactors, different configurations. I take it that  
22 these are all recently calculated numbers? They  
23 weren't available a year ago, or at least you hadn't  
24 assembled them a year ago, when we were asking you  
25 about 4 by 881s?

1                   A. No, we hadn't. We didn't start the  
2 work until, at the very earliest, mid-July of 1991 for  
3 the first phase of it.

4                   Q. All right. Could you turn up Exhibit  
5 519, which is your overheads, page 77.

6                   A. Yes, I have that.

7                   Q. You have just indicated the common  
8 shared facilities.

9                   Indeed, Mr. Penn, I recall in your  
10 evidence in chief when you listed the seven main  
11 characteristics of existing nuclear system the fourth  
12 was that you had an integrated four-unit design, and  
13 the quote I have of you is:

14                             They take advantage of economies of  
15                             scale associated with large stations and  
16                             the ability of multi-unit stations to use  
17                             common facilities.

18 Do you recall that?

19                   A. Yes, I do.

20                   Q. Can we just discuss briefly those  
21 economies of scale associated in particular with the  
22 ability of multi-unit stations to use common  
23 facilities?

24                   You have mentioned containment is shared  
25 to some extent; I mentioned, I think you agreed,

1 control, control room and vacuum building. There would  
2 be other facilities, too?

3 A. There would be shared fueling  
4 systems.

5 Q. Shared fueling systems. The fueling  
6 base, for example?

7 A. Yes.

8 Q. What other fueling systems?

9 A. Well, I was talking about refueling  
10 of the reactors, several of the trolleys can access  
11 several of the reactors, so there is a shared system.

12 Q. These are the trolleys that have the  
13 fueling machine?

14 A. Yes.

15 Q. All right. Fuel handling capability?

16 And I believe I saw emergency core  
17 cooling as a partially shared system - the reservoir,  
18 for example?

19 [10:40 a.m.]

20 A. That's quite correct, yes.

21 Q. Okay. And there would be other  
22 facilities shared?

23 A. Well, yes, there would be shared  
24 administration building, and there would be shared  
25 maintenance facilities, there would be shared simulator

1 training, there would be shared infrastructure of the  
2 site.

3 Q. Some of that infrastructure, I  
4 presume, could be shared even if you built these four  
5 separate if they were proximate to one another?

6 A. If they were close to each other,  
7 yes, you could have shared security, for example, you  
8 could have shared administration building.

9 Q. But the hardware that we spoke of  
10 initially obviously could not be shared if you didn't  
11 have a multi-unit as opposed to four.

12 A. No, they would all be separate.

13 Q. With that in mind, if you could look  
14 at page 77, and I believe that the same pattern occurs  
15 on page 83. I see that the lower range of LUEC offered  
16 for a four unit station is 3.7 cents, whereas the lower  
17 LUEC offered for four single units is 3.4, and I was  
18 interested in how that could be possible given that the  
19 single units wouldn't have these economies we have just  
20 spoken of?

21 A. Well, we are comparing here, first of  
22 all looking at the top bar, the 3.7 cents is for a 4 by  
23 881 or an updated Darlington design on an existing  
24 site.

25 If we look at the bottom bar which is

1 labelled four CANDU single units, then the 3.4 is the  
2 building of four separated but close together CANDU 9s  
3 on an existing site, which for illustrative purposes in  
4 this information is taken to be the Darlington site.

5 The reason for the reduction from the  
6 Hydro design to the AECL design - and I might add that  
7 in these figures also the CANDU 9 has a contingency of  
8 25 per cent on its capital cost, whereas the 4 by 881  
9 has a 15 per cent contingency on its capital cost  
10 because it's a proven design - the main reason lays in  
11 the very high degree of modularization that's  
12 incorporated, as I understand it, in AECL's CANDU 9  
13 design, which is the same concept as the CANDU 3  
14 design, and, the fact that the design of the CANDU 9 is  
15 based upon the existing Darlington reactor, an exact  
16 replica.

17 Q. How reassuring.

18 I take it there has never been a CANDU  
19 9 --

20 A. There is nothing wrong with the  
21 reactor.

22 Q. All right.

23 A. There might be something wrong with  
24 the primary heat transport circuit, and I am sure we  
25 will talk about that later.



1 Q. We will try not to miss it.

2 I take it there has never been a CANDU 9  
3 or a CANDU 3 built anywhere?

4 A. You are quite right.

5 Q. Also if you would turn to page 77  
6 again, I see I think single units, middle bar, I'm  
7 sorry, the lower bar, starting at 3.4 when they are  
8 built four up, or when they are planned four on a site,  
9 as you have indicated, whereas single units where you  
10 don't plan to build another three start at 4.8.

11 Is the 4.8 also a CANDU 9?

12 A. Yes, it is, on an existing site.

13 Q. So, the first unit you go to build  
14 would in fact I take it be closer to the 4.8 than the  
15 3.4? The 3.4 is an average figure taking into account  
16 economies, the cookie cutter economies I think it has  
17 been referred to in subsequent units?

18 A. Yes, someone did refer to it that  
19 way. And you mentioned earlier a scaling factor, based  
20 upon our experience in building multi-unit stations and  
21 AECL's work, the scaling factor of going from 1 to 4 is  
22 between -- is a saving between 27 and 30 per cent,  
23 depending on the design.

24 Q. That saving would be available in the  
25 second and subsequent units, I take it?



1           A. Yes, it's mainly provided as you go  
2       from first to second to third to fourth. And of course  
3       it depends upon the period of time that's assumed  
4       between building each of them.

5           Q. Yes. And what we are talking about  
6       is savings, for example, on subsequent engineering for  
7       the second unit, and so on, specifications and so on?

8           A. Very many things that I could list,  
9       if you wished.

10          Q. As long as I understand the category  
11       that's sufficient for our discussion.

12                So then my question was, the first unit  
13       would in fact cost more like the 4.8 than the 3.4, and  
14       presumably your estimate is that the subsequent units  
15       would cost somewhat have less than the 3.4, so once we  
16       had built four the average was 3.4, is that correct, on  
17       a net present value basis?

18           A. No, I don't think it is correct. The  
19       4.8 assumes that it is a single unit, and that is all  
20       that is ever going to be on that site. So the total  
21       infrastructure and the site clearing is totally borne  
22       by that single unit. But if you were to decide to  
23       build four and to have them literally nine months apart  
24       in-service, then the infrastructure costs and all the  
25       other costs would be shared.

1 Q. But to get the first unit in place,  
2 you would have to do all the infrastructure work?

3 A. Yes, you would. But you would  
4 finance it and you would depreciate the cost of this  
5 group of units in the same way as we depreciate them  
6 for a four-unit station.

7 Q. Mr. Penn, let me explain my  
8 difficulty. If we were looking at nuclear options that  
9 are smaller, single units, more modular, in order to  
10 obtain the kind of flexibility advantages we have heard  
11 you speak of, wouldn't part of the flexibility be that  
12 you may choose or not choose to built subsequent units?

13 A. Well, if the load growth suddenly  
14 significantly dropped, then you may make that decision,  
15 but as we know from experience, that is a very costly  
16 decision.

17 I think it is speculative. I can't  
18 answer the question except that all these matters will  
19 be taken into account.

20 Q. I certainly agree it's speculative,  
21 we are talking many years from now. But if we wanted  
22 to look at this on an incremental costing basis, to get  
23 that first unit in place would cost more like the 4.8  
24 whether you built it with the intention of later  
25 building subsequent units on that site, in which case

1 it may even cost more because you go for a larger site,  
2 or not; isn't that fair?

3 A. No, I don't agree.

4 Q. Let me pose the question more simply.

5 Suppose you plan to build four, you went  
6 ahead and got the first one built or partly built and  
7 decided we won't build the other three, what would be  
8 the LUEC of that first unit?

9 A. Well, then it would revert to  
10 something like a single. It may even be higher because  
11 you may have to write-off costs if in fact you decided  
12 to never complete the stations.

13 Q. All right. So when we get to Panel  
14 10 and we are talking about avoided costs, if we wanted  
15 to isolate the avoided costs of the first unit and deal  
16 with it as a block, that is independent of the others,  
17 we could use as a proxy the single unit costs, given  
18 the assumption I have just given you?

19 A. I think it's a hypothetical situation  
20 you are putting to me and I am afraid I can't help you  
21 with avoided costs because I don't calculate them.

22 Q. All right.

23 A. I am just the engineer that designs  
24 the thing.

25 Q. Perhaps we will revisit that with the

1 system planners then.

2 Mr. Chairman, I did receive this morning  
3 from another party an interrogatory answer dated April  
4 1st, and let's hope it's not in jest.

5 Mr. Lucas I think has copies of it, it is  
6 9.14.68A.

7 THE REGISTRAR: That will be number .68.

8 ---EXHIBIT NO. 520.68: Interrogatory No. 9.14.68A.

9 MR. D. POCH: Q. Am I correct, Mr. Penn,  
10 this is a document which includes some further  
11 information on your preliminary analysis of other  
12 nuclear options and includes the scaling factor, one of  
13 which you referred to earlier?

14 MR. PENN: A. Yes, it's a response to an  
15 inquiry by the Independent Power Producers' Society to  
16 provide more detail and background, and in fact a  
17 disaggregation of costs that appears on figure 76, 77,  
18 80, 82 and 83, in Exhibit 519, which was my direct  
19 evidence on the subject of the preliminary nuclear  
20 option review.

21 Q. All right. I must say this is  
22 helpful to get and it will shorten things a little.

23 I take it that some of the numbers for  
24 some of the options come from the - I think you  
25 referred to vendors in your evidence in chief?

1                   A. Yes. I and others, as I said in my  
2 direct evidence, consulted with major vendors in the  
3 world, both of course here in Canada and the United  
4 States, France, Sweden, Britain, and I was in touch  
5 also with Japan.

6                   Q. All right. And AECL was one such  
7 vendor?

8                   A. Yes, it was.

9                   Q. And they are the vendor you relied  
10 upon for which of the options?

11                  A. For the base overnight construction  
12 costs for the CANDU 3, the CANDU 6, and the CANDU 9.

13                  Q. All right. So variations on that  
14 theme, if you will, were the evaluations you made,  
15 scalings you made, for segregating units or changing  
16 timing, that sort of --

17                  A. The numbers provided in our evidence  
18 are Ontario Hydro's position, mine in particular, on  
19 these costs. We did have discussions with AECL on  
20 these matters as we did with other vendors.

21                  Q. So I take it the principal number you  
22 are relying on AECL for is the initial dry capital cost  
23 as you have adjusted it - I am not suggesting their  
24 number is the same as yours - but that's the key area  
25 where you have relied on them?



1                   A. AECL provided us with the overnight  
2       construction costs, without any owner's cost, i.e., any  
3       Hydro costs on them. And so, we relied and then we  
4       reviewed their basic number as a vendor of a nuclear  
5       island.

6                   Q. I understand. In essence, it's as if  
7       they parachuted in the technology, it landed on your  
8       site, instantly built, and then the site was your  
9       concern and running it was your concern and fueling it  
10      and decommissioning, and so on, was your concern?

11                  A. And many other things such as it's  
12      approval, such as the site preparation, such as gaining  
13      regulatory permits from various ministries and the  
14      Atomic Energy Control Board, et cetera.

15                  Q. Mr. Penn, I am not sure you will  
16      agree, but I would suggest that AECL is quite a nuclear  
17      promoter and my question is: Does it worry you that  
18      their estimate might be an unduly optimistic one in  
19      that when it perhaps comes time 10 years from now,  
20      whenever, to buy such a reactor, if that were to be the  
21      path taken, the price might creep up?

22                  A. Well, all vendors like to put the  
23      best light on their product obviously, and we assess  
24      these costs very carefully. I am quite sure the  
25      vendors would feel that what I have presented and what



1 my staff have presented here are duly high.

2 Q. I am sure they do feel that way.

3 In fact, AECL has used some pretty  
4 aggressive sales techniques in the past; haven't they?

5 A. I am afraid I don't know. I am not a  
6 party to them.

7 Q. Perhaps see if I can jog your memory.  
8 Could you turn up our second volume of materials,  
9 Exhibit 578, at page 5.

10 [10:55 a.m.]

11 A. Yes, I have that.

12 Q. This is a press report of AECL. It  
13 is headed \$4 Million Bribe Given on CANDU Argentina  
14 Sale, and it refers to AECL being the source of at  
15 least 2.5 of that in the lower highlighted section.

16 And similarly, there is a follow-up page,  
17 a piece following, and perhaps just to complete that,  
18 before I ask you to comment, at page 8 there is an  
19 excerpt from an article by Mr. Gordon Edwards which  
20 appears in a book by Mr. Regehr, which notes the  
21 following:

22 In 1976 the Auditor General's  
23 Report --

24 MR. B. CAMPBELL: I'm sorry, where are  
25 you reading from?

1 MR. D. POCH: I am reading from the  
2 bottom of page 8 and onto page 9?

3 The Auditor General's Report revealed  
4 that on top of its \$100 million loss AECL  
5 had committed major financial  
6 indiscretions in connection with the  
7 Argentinian and Korean sales, including  
8 the payment of huge sums in unauthorized  
9 agents fees. In the case of Argentina,  
10 AECL deposited 2.5 million in an  
11 anonymous Swiss bank account. The  
12 identity of the recipient was never  
13 discovered. In the case of Korea, Shoul  
14 Eisenberg of Tel Aviv received \$18  
15 million in unaccountable payments from  
16 AECL. Amidst charges of bribery,  
17 corruption and kickbacks, the House of  
18 Commons Public Accounts Committee  
19 launched an investigation. However, the  
20 Committee was denied power of subpoena by  
21 the Liberal majority on the Committee.  
22 AECL refused to present its books for  
23 inspection and top AECL officials  
24 stonewalled the Committee by refusing to  
25 answer questions. The Committee reported

1                   that AECL witnesses were reluctant,  
2                   uncooperative and evasive in testifying.

3       And the Committee's conclusion is noted here:

4                   The successful concealment by complex  
5                   and sophisticated payment and banking  
6                   procedures in foreign countries of the  
7                   identities of the ultimate recipients of  
8                   the funds and the nature of services  
9                   rendered leads your Committee to suspect  
10                  that some of the payments were indeed  
11                  used for illegal or corrupt payments.

12       Mr. Penn, do you recall this episode in  
13       general?

14                  MR. PENN: A. I certainly remember  
15       reading about it in the press, in the mid-70s was it?

16                  Q. Yes, in '76 I believe is what the  
17       story says, and the \$4 million evidence surfaced, at  
18       least to the Toronto Star, in 1985.

19                  I am not going to ask you to speak for  
20       AECL or say whether you believe bribes occurred or not,  
21       but doesn't the existence of such reports lead you to  
22       raise concern in your mind that AECL may be a  
23       particularly aggressive marketer and optimistic price  
24       quoter?

25                  A. I don't think the two are connected

1       whatsoever. Ontario Hydro has used AECL as a major  
2       consultant for more than 30 years, and I have no idea  
3       what the truth is in this article or this allegation.

4                   I read that the matter was reviewed by a  
5       Parliamentary Committee and I presumed they reached  
6       some conclusion, but I don't have knowledge of it, and  
7       I have no reason to feel that - since there was no  
8       actions taken by our Federal Government - I have no  
9       reason to believe that there is truth in the matter. I  
10      just don't know.

11                   Q. Fair enough. Mr. Penn, there was  
12      passing reference to a loss of I think it was \$100  
13      million on a reactor sale. Are you aware of the fact  
14      that -- or can you comment whether or not AECL has made  
15      profit on its export sales?

16                   A. I really can't comment, Mr. Poch. I  
17      can't imagine them being in business all this long time  
18      if they continually make a loss.

19                   Q. They would need significant  
20      subsidies, wouldn't they, to stay afloat; would they  
21      not?

22                   A. Well...

23                   Q. Well, perhaps we will take that up  
24      with AECL's witnesses when they arrive.

25                   MR. HAMER: Mr. Chairman, I have been

1 keeping myself firmly attached to my seat up to this  
2 point.

3 I hadn't thought that this was an inquiry  
4 into the past of my clients and to read press reports  
5 into the record from events in the middle of the 1970s.  
6 It seems to me that if this inquiry is going to turn  
7 into a situation in which intervenors are going to have  
8 scandalous allegations put to witnesses who know  
9 nothing about the allegations I would presume that  
10 someone in Mr. Poch's position would be undertaking to  
11 call proof of such allegations. However, that is not  
12 what this inquiry is about.

13 MR. D. POCH: Mr. Chairman, I thought I  
14 had just indicated that I would clearly be willing to  
15 discuss this with AECL's witnesses who would be in the  
16 best position to know, and obviously, from the press  
17 reports, if we take them at their face, there has been  
18 a Committee finding of some reluctance on AECL's part  
19 to give the evidence and if my friend is concerned with  
20 the suggestion, then I would say the simple remedy is  
21 to instruct his witnesses to be prepared to be  
22 forthright in answer to such questions.

23 MR. HAMER: Well, I would say, Mr.  
24 Chairman, that all that is relevant to this hearing is  
25 whether Ontario Hydro scrutinized the information that



1 was given to them by a prospective vendor, and what is  
2 not relevant to this hearing is allegations that may  
3 have been advanced in the 1970s.

4 Certainly, I wouldn't anticipate that  
5 AECL would be presenting witnesses prepared to talk  
6 about events that were canvassed and scrutinized  
7 carefully back in the 1970s.

8 MR. D. POCH: Well, Mr. Chairman, I have  
9 no further questions for this panel in any event on  
10 this.

11 THE CHAIRMAN: Thank you, Mr. Hamer.

12 I do think in general that those are very  
13 serious, unsubstantiated allegations that were put to  
14 these witnesses, and I do think there should be some  
15 considerable restraint in that area.

16 If Mr. Penn or the other witnesses know  
17 nothing about these things I think it serves little  
18 purpose to put them on the record at this time.  
19 Certainly, it makes no impression whatsoever on me. I  
20 am completely not in the slightest bit accepting or  
21 even concerned about those statements. But if  
22 witnesses want to come and give that kind of evidence,  
23 and we think it is relevant, we will deal with it at  
24 that time.

25 MR. D. POCH: Thank you, Mr. Chairman.



1                   MR. B. CAMPBELL: Mr. Chairman, I just  
2     want to note that I was listening very carefully to  
3     this as it all happened, of course, and that, in fact,  
4     I would just like to note that at this point on the  
5     record the only question that has been put and that can  
6     in my submission be used in any evidentiary sense at  
7     all is whether having read a newspaper articles of this  
8     type over the course of a long and illustrious career  
9     Mr. Penn believes they affected cost estimates. He has  
10    been unequivocal in his answer, no, and, as far as I am  
11    concerned, that is the only evidence that has arisen  
12    from this whole thing, and, in my submission, your view  
13    of the treatment of the remainder of the discussion,  
14    and in particular the allegations, in my submission is  
15    precisely correct.

16                  MR. D. POCH: Mr. Chairman, I can  
17    certainly assure you that is all I have taken from my  
18    questions to the witnesses.

19                  THE CHAIRMAN: We have said many, many  
20    times that this kind of material presented to the  
21    witnesses is not in any sense evidence and they are  
22    only there in order to assist the witnesses in  
23    answering questions that they are asked.

24                  But I do think when you get evidence of  
25    this nature which alleges impropriety against a major

1 party at this case, that those questions ought to be  
2 asked with great restraint.

3 MR. D. POCH: Mr. Chairman, as I say, we  
4 will take that under advisement, and if and when AECL  
5 leads evidence and if we have concerns about the  
6 credibility of them AECL we will consider whether or  
7 not to raise it at that time.

8 Q. Gentlemen, moving on, when did you  
9 receive the evidence, Mr. Penn, the information you  
10 have from AECL on the cost estimates? Let's deal with  
11 CANDU 600 by way of example, or CANDU 6. By the way,  
12 600 and 6 are synonymous?

13 MR. PENN: A. Yes, they are, yes.

14 Q. When did you receive the information  
15 that you are now presenting to the Board?

16 A. I believe we met with AECL in late  
17 September, early October for a period of two days,  
18 having contacted them prior to tell them what we were  
19 interested in, and then subsequently we received more  
20 technical detail in written form, which I decided in  
21 direct evidence -- since it would be inappropriate to  
22 spend a lot of time with this Board talking about the  
23 detailed technical design of every option, I didn't  
24 include in my evidence.

25 Q. So there is some further information

1       you have from AECL which is not yet part of the record?

2               A. There is information that we have  
3       been advised has commercial restriction to it, which we  
4       have.

5               Q. All right. I had asked Mr. Campbell  
6       at the time the Update was issued to provide us with  
7       the costing study behind the CANDU 6, which I think we  
8       agree the Update is based on that as the representative  
9       option, CANDU 6?

10              A. Yes, it is an illustrative example.

11              Q. And it is based on four single units?

12              A. Yes, it is.

13              Q. So it would have been the lower cost  
14       of the ones we were referring to earlier, 3.4 or  
15       rather --

16              A. Subject to check, and I think there  
17       is an interrogatory answer on this subject, I think you  
18       are right.

19              Q. All right. And, I'm sorry, it is  
20       roughly 4.0 as opposed to the higher numbers.

21              We will come back to this momentarily.  
22       If you turn in Exhibit 577, our first volume, at page  
23       229, this is Interrogatory 9.9.43. I believe it may  
24       have already been referred to in the evidence.

25              THE REGISTRAR: 9.9.43?

1 MR. D. POCH: Yes.

2 THE REGISTRAR: I don't see it here. .69.

3 ---EXHIBIT NO. 520.69: Interrogatory No. 9.9.43.

4 MR. D. POCH: Q. You provided us here  
5 with four pages of information ending at page 233 of  
6 our exhibit.

7 Apart from the information here and the  
8 information we spoke of earlier, including .68, is  
9 there any other costing information on CANDU 6 that has  
10 been provided that has not in fact been provided to us;  
11 are you aware?

12 MR. PENN: A. No.

13 Q. All right.

14 A. No, I have provided this information  
15 as you can see, Mr. Poch, in summary form.

16 Q. Yes.

17 A. We have provided levelized unit  
18 energy costs, we have provided total capital costs, and  
19 we have provided OM&A costs in another document, and in  
20 the letter that you referred to earlier where IPPSO  
21 asked for disaggregation, we included more detail,  
22 including there the CANDU 6.

23 Q. Right. So in fact, that is the most  
24 detail we have, then, that Exhibit 520.68 which was the  
25 IPPSO interrogatory?

1                   A. Yes. That is extreme detail. That  
2 is the same level of detail as the 4 by 881.

3                   Q. All right. In fact, Mr. Penn, there  
4 is really only one area at the moment which I would be  
5 inclined to ask for more information on this.

6                   A. Are you looking at the moment at --

7                   Q. Now I am looking at Exhibit .68, and  
8 there is a spreadsheet at the back.

9                   A. That is on the last page?

10                  Q. Yes.

11                  A. Yes, I have that.

12                  Q. The various options have different  
13 end dates, and that appears in the header boxes for  
14 each column?

15                  A. That is right.

16                  Q. Or start dates, I guess, that would  
17 be. In-service dates?

18                  A. That is the in-service date of the  
19 first unit, and, of course, it is the in-service date  
20 of the actual unit if it is a single option that we are  
21 looking at.

22                  Q. The only difficulty I have is, if for  
23 example we take CANDU 6, you give an existing site  
24 value starting in the year 2003 and a new site in 2007,  
25 and I assume the reason for that is that it does indeed



1 take a few more years to obtain a new site and all that  
2 is involved?

3 A. Yes. Well, we have assumed that in  
4 the case of a new site that it would take us -- first  
5 of all, we have to purchase it. Secondly, we have to  
6 thoroughly review the environmental impact of whatever  
7 the option is. And therefore, there is more time in  
8 that approvals process for a new site than an existing  
9 site required. Then, also, we are assuming that a new  
10 site would take longer to prepare for construction and  
11 at least a year more to construct.

12 That is just a basic assumption that we  
13 have made, to assume that the new site could possibly  
14 be more difficult, if you wish, to prepare than an  
15 existing site where Darlington was taken as an example.

16 Q. All right. And in the -- excuse me.  
17 I'm sorry, Mr. Penn.

18 If you could take out the materials  
19 provided by the Canadian Nuclear Association, the bound  
20 materials, and I am looking behind tab 2. This is  
21 Exhibit 520.29.

22 A. Yes, I have that.

23 Q. First of all, I take it that the  
24 preliminary review you speak of is the second  
25 attachment to the accompanying interrogatory 9.2.118



1       there?

2                   A.   Yes, it is.

3                   Q.   The type face changes on it.

4                   A.   Its format is in columns.

5                   Q.   Yes.   If we go to the back of that,  
6   the second last sheet of that --

7                   A.   Yes.   That is table 4.5.

8                   Q.   Yes, that is right.   I see a similar  
9   although horizontal array of some of this information,  
10   and I am wondering if you could just clarify the  
11   distinction between option No. 1 and 1B.   They are both  
12   4 by 881 megawatt on existing site, in-service in 2005,  
13   yet they have different initial capital costs.

14   [11:15 a.m.]

15                   A.   Yes.   That's described on page 7 of  
16   the document, .6, halfway down on the left-hand column.  
17   It says, and I will read it:

18                   Option 1B is the same as option 1  
19                   except for a larger time interval of  
20                   three years between the commissioning of  
21                   the second and third units.   Option 1B is  
22                   included to investigate the feasibility  
23                   of committing and building an integrated  
24                   station in pairs of units.

25                   Q.   Fine.   Mr. Penn, the reason I brought

1 your attention to that is, it was the only place I was  
2 able to find where we had the same configuration on the  
3 same type of site where we could try to discern what  
4 the difference would be in capital cost simply by it  
5 taking longer or starting later. I see that the LUEC  
6 is higher for option 1B. From that am I correct in my  
7 understanding that nuclear capital cost escalation  
8 indices that you use for calculating these costs are in  
9 fact - at least in the early 2000s - rising faster than  
10 general inflation, so the longer it takes to get to the  
11 station, the more it costs?

12 I assume there are two factors at play  
13 here, that and the interest carry costs.

14 A. Well, I don't have in my mind what  
15 the numbers are for things like escalation and discount  
16 factors in the first decade of the next century. It  
17 would be one of the factors.

18 Another factor, of course, is the lack of  
19 continuity of the construction work-force, and that I  
20 think would dominate the issue. And ordering of  
21 equipment, for example, would be another example of the  
22 increase of costs.

23 Q. Mr. Penn, would it be possible to  
24 take the table you provided at the last page of Exhibit  
25 .68 where you broke out LUEC by the various components

1 for the various options, and express those - and I am  
2 not suggesting that you need do this today - but  
3 express those all at a common in-service date? And I  
4 would like to suggest that it would be most helpful,  
5 given Hydro's expression of a need date of 2010, late  
6 2009 to 2010, and my question would be if it would be  
7 possible to provide all of those at that date so that  
8 we are able to both contrast, for example, existing  
9 versus new site with a common date and also compare  
10 option costs at 2010 versus an earlier time so we can  
11 see to what extent time is a factor. Is that something  
12 you can --

13 A. I think I can help you now, given  
14 that we are not looking for accuracy in the third  
15 decimal place.

16 Q. All right.

17 A. The rule of thumb on this type of  
18 generating station, a nuclear station, is that the  
19 levelized unit energy cost would increase between .8  
20 and 1 per cent of LUEC per year. So that if you had a  
21 value at 2005 and you wanted it at 2010, and the LUEC  
22 at -- we look at the first column on the left, it was  
23 3.73 cents per kilowatthour, then going from 2005 to  
24 2010, you would have about .02 cents per kilowatthour,  
25 being 5 per cent of 4 cents.

1 Q. In fact, it would be --

2 A. It would be small.

3 Q. .8 to 1 cent and you would in fact,  
4 in an actual calculation, compound it, correct?

5 A. That's why in this table, and with  
6 the advanced light water reactors that I gave costs for  
7 in direct evidence, I didn't feel that it was necessary  
8 to normalize all these things because we know what the  
9 relationship is and it is not a big factor.

10 Q. All right. Just to be clear, the .8  
11 to 1 cent, you would compound that annually?

12 A. .8 to 1 per cent.

13 Q. Per cent, I'm sorry.

14 And you would compound that annually. I  
15 know it is a very slight difference, but just so we are  
16 accurate if we are doing such calculations.

17 A. I haven't compounded it annually. I  
18 just did it on a simple basis. I think that's getting  
19 too much finessing.

20 Q. So if we just add up 1 per cent per  
21 year that is a good approximation?

22 A. Yes, it is.

23 Q. With that I think we have the various  
24 sensitivities, perhaps with the exception of one.

25 I had taken it from the information

1 provided, indeed the information in your preliminary  
2 estimate table 4.5 of Exhibit 520.29, that you use an  
3 80 per cent nominal average capacity factor. Now we  
4 will come to the distinctions later, Mr. Daly, between  
5 capacity factor and capability factor, and so on. But  
6 if we wanted to change the capacity factor  
7 significantly, perhaps 5 or 10 percentage points, is  
8 there a sensitivity we can use for the various options?

9 A. Yes, and it's provided in the ONCI  
10 document, Exhibit 43, where there are sensitivity  
11 analyses for all dominant parameters, one of which is  
12 the assumed capacity factor.

13 Q. We will come to that. I take it that  
14 was provided in the context of 4 by 881, but you are  
15 comfortable applying that to the other options as well?

16 A. Well, I would have to think about  
17 whether there is any reason for a different  
18 sensitivity, but off the top of my head I would think  
19 it is quite appropriate.

20 Q. I am sure you can think of a  
21 different reason not using 80 per cent at this point in  
22 time.

23 A. We believe strongly that 80 per cent  
24 capacity factor is a reasonable assumption.

25 It's interesting that in the United



1 States, for example, with improvements they are making  
2 in their designs and with much longer life of their  
3 fuel assemblies, that utilities and vendors alike are  
4 adamant that their capacity factors in the future will  
5 be higher.

6 When we looked at advanced light water  
7 reactors, we stayed at 80 per cent because we felt that  
8 was the conservative thing to do, but they would have  
9 had us make it 85 per cent or more.

10 Q. 80 per cent is not in fact your  
11 current median projection, is it, Mr. Daly, for the  
12 system?

13 MR. DALY: A. For which units and which  
14 period of time?

15 Q. I can see if it's that varied,  
16 perhaps we will leave that for a moment, I am going to  
17 come to a section in cross that deals with this and we  
18 come back and sort all that out.

19 A. Just while I am on here, Mr. Poch, I  
20 would like to refer you also to some interrogatories  
21 which have been tabled which give some information on  
22 the variation of LUEC with capability factor. These  
23 are 9.30.2 and 9.30.3. So, I think these complement  
24 the ONCI information that Mr. Penn has referred to.

25 Q. Fine. We will look at these perhaps



1 at the break before we come back to this.

2 THE CHAIRMAN: Perhaps those should be  
3 given a number.

4 THE REGISTRAR: 9.30.2 is .70; 9.30.3 is  
5 .71.

6 ---EXHIBIT NO. 520.70: Interrogatory No. 9.30.2.

7 ---EXHIBIT NO. 520.71: Interrogatory No. 9.30.3.

8 MR. D. POCH: Q. Now, just in terms of  
9 the evolution of your cost estimates, if we turn up  
10 Exhibit 577, our background materials, first volume, at  
11 page 1, we have provided an excerpt of the  
12 demand/supply option study.

13 Mr. Penn, at that time in 1986 you were  
14 looking at seven types of reactors and configurations?  
15 First of all, do you agree with me on that?

16 MR. PENN: A. We were looking at the  
17 single-unit 300 megawatt station, that of course is  
18 CANDU 3 which is now upgraded to 450 megawatts.

19 Q. Perhaps I could just refer the Board,  
20 at page 10 of our material I see a summary of options  
21 for Phase 2.

22 A. Thank you.

23 Q. Perhaps you could just confirm in  
24 fact that was the extent of your investigations or your  
25 considerations at that time.

1 I am sorry, that is the extent of the  
2 ones that you retained for Phase 2, so it would have  
3 presumably been broader in Phase 1?

4 A. Well, this document, which is a  
5 system planning document, was produced in 1986, I  
6 believe, and is the forerunner of the preparation for  
7 the Demand/Supply Plan, and Phase 2 was the more  
8 detailed work done on these retained options in the  
9 period of 1987/88, as I recall. As you can see, we  
10 dropped two options from the consideration.

11 Q. Including the 1 by 300 AECL option?

12 A. Yes.

13 Q. And if we look at Exhibit 3, Balance  
14 of Power, at page 14-32. Backup, in fact, to page  
15 14-31, this is a discussion of the CANDU options  
16 considered by the time we get to this document, this is  
17 after then the DSP you just referred to, and there  
18 were --

19 A. This was written, yes, after that  
20 Phase 2 study was complete.

21 Q. We see at the bottom of page 14-31  
22 the rationale for selecting 4 by 881 which was styled  
23 option 11, and for not selecting option 12, which is  
24 CANDU 3, which is the newer 300 megawatt version from  
25 AECL; is that correct?

1 A. Yes.

2 Q. So I take it when you did your  
3 analysis or when the system planners did their analysis  
4 here they were really only looking at two options.

5 A. It appears that way. I am rather  
6 surprised actually.

7 Q. Is it your impression that there were  
8 some other options retained at that time?

9 A. It was certainly my impression that  
10 the CANDU 3 at that time just was much too small a  
11 capacity really for Hydro to seriously consider,  
12 because at that time the load growth was growing at 600  
13 megawatts a year.

14 Q. Indeed it is rejected in this. I  
15 didn't mean to suggest to you that it had been retained  
16 beyond.

17 A. I don't think the CANDU 6 was  
18 particularly bypassed at this time, but clearly the 4  
19 by 881, given the large requirement in the next  
20 century, some 8,000 megawatts, if I recall, to the year  
21 2014, was an appropriate choice amongst many other  
22 reasons for it.

23 Q. Let's be clear, you say CANDU 6  
24 wasn't bypassed, but indeed options were considered  
25 including the 1 by 600 back at the time of the DSOS,

1 it's listed there we saw a few moments ago, and one by  
2 one these options are considered and rejected, are they  
3 not, apart from the 4 by 881?

4 A. You are quite right.

5 Q. So there was a narrowing-down process  
6 which is not atypical in environmental assessments?

7 A. Yes. There was.

8 Q. To arrive at your preferred options?

9 A. Yes, there was.

10 I suggest that I don't recall why CANDU 3  
11 was discussed in this document rather than some other  
12 option, but I'm sorry I just don't recall.

13 Q. That is fine.

14 And indeed, in 1988 if we turn up page 11  
15 of our background materials, Exhibit 577, this is an  
16 excerpt from what is Exhibit 68 in these proceedings,  
17 review of Ontario Hydro's draft planning strategy by  
18 the Electrical Planning Technical Advisory Panel which  
19 has become known as EPTAP. EPTAP only considered the  
20 costs you put forward, I take it, of 4 by 881? That's  
21 what they focused on, in any event?

22 A. Well, this particular committee,  
23 Technical Advisory Panel, which was constituted, I  
24 believe by the Minister of Energy, provided - and of  
25 course many other people provided at that time -

1 commentary on the strategy that led eventually to the  
2 Demand/Supply Plan.

3 I cannot tell you whether this committee  
4 provided more than the 4 by 881 or not. I'm sorry, I  
5 don't know.

6 Q. But indeed, if we just look at the  
7 excerpts we provided, on page 34 of their report, in  
8 the middle paragraph --

9 A. We are on page 12 now?

10 Q. We are on page 12, that's correct, of  
11 our exhibit.

12 They note that:

13 To pursue the question of CANDU costs  
14 beyond the information presented in the  
15 report we asked Hydro a number of further  
16 questions and the responses did not allay  
17 our concerns but raised further  
18 questions. See appendix C.

19 And I have provided appendix C. And they  
20 there express a number of questions, anyway, for  
21 example, under the planning costs below Darlington  
22 costs, projected costs for the new Darlington nuclear  
23 station are now substantially higher than the costs of  
24 the generic nuclear unit used for planning, and they go  
25 on.



1                   A. I'm sorry, where were you reading  
2                   that last sentence?

3                   Q. Page 13 of our exhibit, immediately  
4                   under the heading planning costs below Darlington  
5                   costs.

6                   A. I thought we were on page 12.

7                   Q. I'm sorry. That was just where the  
8                   reference to appendix C appears, in the body of the  
9                   report.

10                  A. Thank you.

11                  Q. They were struck by the fact that the  
12                  generic nuclear plant costs you were using, I guess it  
13                  would have been called CANDU A, at that time were  
14                  falling, yet Darlington costs were rising.

15                  Mr. Penn, do you agree that that was  
16                  indeed -- or at least the Minister's response to that  
17                  was to convene the Ontario Nuclear Cost Inquiry?

18                  A. I don't know whether it was this  
19                  particular document that caused the Minister to call  
20                  the inquiry, but we all certainly welcomed that  
21                  inquiry, and it did follow shortly after this document.  
22                  In fact, the inquiry occurred in October/November of  
23                  1988, and I think this, yes, this particular report was  
24                  written in July '88.

25                  Q. Yes.



1                   A. But when I read this document last  
2 night there are considerable factual errors in it and I  
3 really don't know what the context of it is because we  
4 start reading at page 34 and so I don't know.

5                   Q. It is an exhibit in the hearing, it's  
6 Exhibit 68, and you may want to have a look at that at  
7 some point.

8                   A. I see.

9                   Q. In any event, it was following EPTAP  
10 that the government convened the Ontario Nuclear Cost  
11 Inquiry; correct?

12                  A. Yes, it was shortly after.

13                  Q. And indeed, if you look on page 34  
14 still of the EPTAP report, there the committee in the  
15 last paragraph expresses concern. They were unable to  
16 verify accuracy, validity or reliability of your cost  
17 estimates, and perhaps we can have sympathy for them  
18 given how complicated these matters are.

19                  Of course, Mr. Penn you would agree that  
20 their inquiry wasn't just about nuclear costs; it was  
21 about electricity planning, it was in a sense analogous  
22 what we are going through here, they had to look at  
23 great number of factors.

24 [11:35 a.m.]

25                  A. Yes, this was one of many issues that

1       they reviewed.

2                   Q.   They say:

3                   In comparing options all costs should  
4                   be included and should be on the same  
5                   basis.

6                   A.   Absolutely.

7                   Q.   All right. So as time progresses we  
8       get to the ONCI report, and it is indeed ONCI updated  
9       somewhat and your submission to ONCI, which is I think  
10      Exhibit 43 in these proceedings, that is where your  
11      analysis of the LUEC, the nuclear option, is spelled  
12      out, I take it? And you rely on that and the Balance  
13      of Power, and I take it you rely on it with some  
14      amendments today?

15                  A.   Certainly, the ONCI document is the  
16      most comprehensive review of costs that Ontario Hydro  
17      has ever done of nuclear energy, and it was based upon  
18      levelized unit energy costs, which while being  
19      developed in other countries at the same time was also  
20      developed at Hydro in late '87/early '88, the process,  
21      and it was used in ONCI.

22                  Q.   And just one more question perhaps  
23      before we break. ONCI looked only at 4 by 881?

24                  A.   Yes, it did.

25                  MR. D. POCH: Mr. Chairman, if it is a

1 convenient time for a break this is appropriate.

2 THE CHAIRMAN: All right. We will break  
3 for 15 minutes.

4 THE REGISTRAR: Please come to order.  
5 This hearing will recess for 15 minutes.

6 ---Recess at 11:38 a.m.

7 ---On resuming at 11:55 a.m.

8 THE REGISTRAR: Please come to order.  
9 This hearing is again in session. Be seated, please.

10 MR. BULLOCK: Mr. Chairman, just before  
11 my friend Mr. Poch gets rolling again, I spoke with Mr.  
12 Johansen about a correction to the record for Volume  
13 128 from yesterday's evidence. Perhaps I could just  
14 read it in? It starts --

15 THE CHAIRMAN: Just a moment. Yes, go  
16 ahead.

17 MR. BULLOCK: Page 22537, Mr. Chairman,  
18 and the errors are found in lines 23, 24 and 25.

19 Just to give a little bit of the context,  
20 then, starting at line 19:

21 Conceivably we could continue to  
22 repackage the fuel in an endless  
23 sequence, and yes, it would be possible  
24 to perpetually store the fuel.

25 And the record presently reads:

1 All right, but we don't have that  
2 planned safely yet.

3 And in speaking to Mr. Johansen that should be  
4 corrected, Mr. Chairman. We think that what happened  
5 was a couple of answers and questions were run  
6 together. So the record should read, Mr. Chairman --  
7 starting at line 22 perhaps would be a good place to  
8 start. The record should read, line 22:

9

10 "Question: All right.

11 "Answer: But we don't have that  
12 plan."

13 And then next question.

14 "Question: And it would be stored  
15 safely?

16 "Answer: Yes, safely."

17 And then simply continuing on with the question:

18 "Then you were talking about the dry  
19 auxiliary storage method?"

20 THE CHAIRMAN: Can you confirm that, Mr.  
21 Johansen?

22 MR. JOHANSEN: Yes.

23 MR. BULLOCK: Thank you very much. Thank  
24 you, Mr. Poch.

25 MR. D. POCH: Q. Gentlemen, just before

1 the break we were about to look at the Ontario Nuclear  
2 Cost Inquiry, and you had agreed it only looked at the  
3 4 by 881 option. Could you turn up that exhibit? It's  
4 Exhibit 44.

5 MR. PENN: A. Yes, I have it.

6 Q. If you would turn with me first of  
7 all to the reporting letter, the first page, it is  
8 dated at the end of January, '89, and in it, it refers  
9 to the letters of October 19th, 1988 to members of the  
10 panel asking them to conduct the inquiry.

11 So that is when this inquiry took place,  
12 between October 19th and January, '89 -- October 19th  
13 of '88 and January of '89?

14 A. That's correct.

15 Q. And I have in my notes, and we can  
16 find the reference, that the bulk of the information  
17 they worked from was your presentation which is also  
18 provided to this Board as Exhibit 43, I believe, and it  
19 is dated November of '88?

20 A. Yes, it is. Actually, though, the  
21 panel - and I don't remember the exact number - but  
22 asked over 100 written questions, which were also part  
23 of the evidence.

24 Q. Right. And those questions arose  
25 during your presentation?



1 A. Yes, they did.

2 Q. So the ONCI report came out 2-1/2  
3 months after your presentation?

4 A. Well, what happened was that there  
5 was a whole series of presentations to the panel, and  
6 then subsequently Ontario Hydro staff took that  
7 presentation material and put it into regular prose.

8 Q. All right. And so the exhibit here  
9 would have come out later in November, but your  
10 presentation was in the earlier part of November of  
11 '88, just so I have the chronology correctly?

12 THE CHAIRMAN: Exhibit 43, is that right?

13 MR. D. POCH: Yes, that's right, Mr.  
14 Chairman.

15 MR. PENN: Yes, that's quite correct.

16 MR. D. POCH: Q. All right. And the  
17 inquiry if we would just turn after the body of the  
18 report, so about several pages past page 102, the  
19 inquiry had principally a chairman, a member and an  
20 advisor, and there are brief bios provided there. Do  
21 you have that? It is about four pages past the end of  
22 the body of the report.

23 MR. PENN: A. You are referring to the  
24 biographies of the panel members?

25 Q. Yes?



1 A. Yes, I have that.

2 THE CHAIRMAN: Two advisors, if it makes  
3 any difference.

4 MR. PENN: Yes, there were two advisors  
5 from EDF.

6 MR. D. POCH: Q. Yes. And we have heard  
7 mention already of them in these proceedings. Just so  
8 we are on the same wave length here, Mr. Brooks was a  
9 past member of the National Energy Board and his brief  
10 bio indicates that his knowledge was primarily in the  
11 area of imports and exports of electricity, as we might  
12 expect. So he is a generalist, but indeed he was  
13 assisted by a member and the advisors who do have some  
14 special knowledge on nuclear costs; is that fair?

15 MR. PENN: A. As far as I am concerned,  
16 Mr. Brooks was very knowledgeable of electric planning  
17 in particular, and I note in his biography that he was  
18 a Chairman of the Electricity Planning Technical  
19 Advisory Panel which reported to the Minister of Energy  
20 on July the 15th, 1988.

21 Q. Yes. Yes. And Mr. Bowers is a  
22 retiree from Oak Ridge National Lab in the States?

23 A. Yes. Mr. Bowers, Howard Bowers, was  
24 part of Oak Ridge National Laboratory for many, many  
25 years.

1 Q. Yes.

2 A. He was one of the founders as a  
3 physicist of the light water reactor designs.

4 Q. Yes. Oak Ridge has quite a  
5 reputation, has a long history of being involved in the  
6 development of nuclear power in fact?

7 A. It is one of the principal  
8 laboratories in the world.

9 Q. Yes. And Mr. Moynet we have heard  
10 mention of. He is actually, when not chairing UNIPED  
11 and so on, employed by EDF, Electricite du France?

12 A. Yes, he is.

13 Q. You can confirm for me, can you not,  
14 that EDF is perhaps the most nuclear-reliant utility in  
15 the world?

16 A. It generates about 72 per cent of its  
17 electricity from nuclear generation.

18 Q. And they have quite an aggressive  
19 nuclear construction program which persists?

20 A. Well, it is not as aggressive as it  
21 was, but it certainly persists.

22 Q. It is waning, I take it, then?

23 A. Well, like every where else in the  
24 world. People are concentrating on demand management  
25 is one reason.

1 Q. Okay. And this group, which I will  
2 call ONCI, if I may use that as the noun, it did not  
3 look at social or environmental costs, and indeed, if  
4 we look on page 3 of the report it says in the second  
5 paragraph:

6 In proceeding to the substance of this  
7 report by the Panel, one should bear in  
8 mind that the mandate of the inquiry is  
9 relatively narrowly focused.

10 And it talks about the observations of EPTAP concerning  
11 nuclear power costs, and they mention it is only one  
12 part of a bigger exercise of reviewing the strategy,  
13 making plans for meeting future electricity needs of  
14 the province.

15 I take it that is your understanding;  
16 they didn't look at the other impacts and costs of  
17 nuclear or other options?

18 A. Well, I don't have the letter of  
19 direction from the Minister to the panel.

20 Q. Well, I can help you. I think at the  
21 bottom of this paragraph indeed they recite that Energy  
22 Minister Wong has said that:

23 The broader social and environmental  
24 issues involved with electricity  
25 generation will be looked at separately

1 in the planning process.

2 A. Yes.

3 Q. All right. The nuclear cost inquiry  
4 did not hold open hearings such as we are having here?

5 A. No, it didn't.

6 Q. No.

7 A. But it did visit widely within the  
8 province facilities, for example.

9 Q. Nuclear facilities?

10 A. And met with quite a number of groups  
11 and people.

12 Q. So is it fair concluding that this  
13 inquiry, composed as it was, had the opportunity to  
14 review Ontario Hydro materials, had the opportunity  
15 presumably to compare it to some other materials they  
16 were familiar with, but didn't go through a process  
17 where they obtained large critical examinations of  
18 those costs from independent groups such as we are  
19 going through here?

20 A. Well, if I recall the wording of the  
21 Minister's letter and the government's wishes at that  
22 time, it was that Ontario Hydro's costs of future  
23 nuclear power should be reviewed by international  
24 specialists in the field. It was narrowed to the fact  
25 that the Minister sought specialists' review as opposed

1 to public review.

2 Q. And indeed, I think the specialists  
3 that assisted the chairman in that proceeding were  
4 indeed from two nuclear-oriented organizations, and  
5 they were in fact part of that inquiry?

6 A. Well, by definition you have to be  
7 part of the industry to be a specialist, I would  
8 suggest.

9 Q. Well, perhaps we will see about that,  
10 but just harkening back to my question, they weren't  
11 assisted by a critical analysis from independent  
12 organizations or parties who are critical of the  
13 option; that is, aren't committed to the option?

14 A. They certainly weren't assisted by  
15 people who were opposed to the option.

16 Q. That's right. They did their inquiry  
17 over the course of approximately 2-1/2 months, as we  
18 said, and this report embodies their views, and I would  
19 like to take you to some of those views.

20 First of all, though, Mr. Moynet sits on  
21 UNIPEDE -- and we heard from the cross-examination of  
22 Mr. Heintzman -- we saw UNIPEDE and OECD comparative  
23 analyses of costs for nuclear options. Both of those  
24 reports, the various reports that Mr. Heintzman  
25 presented, were from the same vintage.



1 [12:05 p.m.]

2 I take it in fact both of those  
3 organizations or surveys would have relied upon Ontario  
4 Hydro in the main to provide the information on Ontario  
5 Hydro's costs.

6 A. Yes.

7 Q. So we shouldn't be surprised that  
8 there is some consistency between ONCI, UNIPEDE and  
9 OECD where Mr. Moynet, in at least two of those if not  
10 the third, would have received predominantly similar  
11 information from yourself?

12 A. Well, we should be quite clear on  
13 this. That the OECD NEA organization has membership of  
14 at least 16 or 20 countries. I personally attended  
15 such meetings. And UNIPEDE also has membership from at  
16 least a dozen countries. And they provide a service to  
17 the world community on an annual basis of updating cost  
18 information, in particular, both operating and capital  
19 costs. And clearly they seek information from the  
20 major utilities in the world and we contribute that, as  
21 I testified earlier, we only recently received a  
22 request through external affairs to contribute this  
23 year.

24 But I imagine that New Brunswick Power  
25 Commission and maybe Hydro Quebec are also asked to



1 give that sort of information.

2 Q. All right. I am just suggesting  
3 then, the 4 by 881 obviously only being extant in the  
4 Ontario, all of those expressions of the cost would  
5 have been relying upon Ontario Hydro's expression of  
6 those costs?

7 A. Yes, we give the costs that are  
8 current.

9 Q. All right. And so if I should be  
10 successful in raising some criticism of those costs  
11 then presumably any weakness in your cost estimate  
12 would be reflected in each of these cost estimates put  
13 forward by these bodies because they were reliant upon  
14 your costing.

15 A. Well, I am very happy for you to be  
16 critical. The whole point of the inquiry was to  
17 determine whether Ontario Hydro produced its costs in a  
18 complete and comprehensive manner. I think if you look  
19 at Exhibit 44 there is some comparison with other costs  
20 in the world to put it into context.

21 Q. Yes, I appreciate that.

22 Let's just look at some of the findings  
23 of the Ontario Nuclear Cost Inquiry. If we could start  
24 at -- I think they are summarized starting at page 90,  
25 but I would like to direct your attention to page 92 of

1 Exhibit 44.

2 A. Yes, I have that.

3 Q. Now, I take it that in general the  
4 inquiry -- they had no problem with your LUEC approach  
5 to costing nuclear, first of all that's fair?

6 A. That's quite fair.

7 Q. They do note at the enumerated  
8 paragraph 4 on the top of page 93, there are other  
9 factors involved though if we want to look at a  
10 comparison.

11 A. Well, absolutely. As I gave in my  
12 direct evidence, there are a number of characteristics  
13 - and cost is one of them - that have to be taken into  
14 account in a decision process.

15 Q. Obviously they don't, as we spoke of  
16 earlier, venture on those points. But in the fifth  
17 one, the fifth enumerated paragraph, they do make the  
18 point, do they not, that LUEC as a methodology for the  
19 comparison tends to de-emphasize major expenses later  
20 in time due to the discounting effect. And you would  
21 agree with that, I take it?

22 A. Well, I don't think it exactly says  
23 that. It says:

24 The further out in time that an  
25 expenditure is made, the less is its

1 effect on the lifetime levelized unit  
2 energy costs.

3 I think that's quite straightforward and  
4 correct.

5 Q. I was taking my comment from the last  
6 sentence there. It says:

7 This tend to de-emphasize the costs of  
8 such major items as large scale fuel  
9 channel replacement, decommissioning and  
10 used fuel disposal.

11 I don't think de-emphasize is being used  
12 in the pejorative sense there, but you would agree that  
13 that is the effect of using LUEC comparisons?

14 A. Well, all it's indicating really is  
15 that the costs of large scale fuel channel replacement,  
16 decommissioning and used fuel disposal relative to the  
17 total costs involved in building and operating plants  
18 right through to decommissioning over more than 40 to  
19 80 years is relatively small. That's all it's saying.

20 Q. They are pointing out, are they not,  
21 that one of the reasons for that is the discounting  
22 effect because those expenditures occur later in time?

23 A. That's one of the reasons. But they  
24 are also small.

25 Q. All right.

1                   A. For example, the total costs of  
2                   operating our nuclear system for one year just in OM&A  
3                   is about a billion dollars.

4                   Q. Right. And similarly, the  
5                   refurbishment retubing of Bruce "A" is about a billion  
6                   dollars; is it not?

7                   A. For all --

8                   Q. For all four?

9                   A. Yes.

10                  Q. And the number you gave me was for 20  
11                  reactors; was it not?

12                  A. For one year's operation only. I am  
13                  trying to put the costs into context.

14                  Q. I understand.

15                  A. We are talking about over such a long  
16                  period of time expenditures that are in the hundreds of  
17                  billions of dollars.

18                  Q. Yes. They gave the example here of  
19                  the LSFCR. I take it that if fuel channel replacement  
20                  has to occur earlier in a unit's life, the LUEC would  
21                  go up because of this time effect?

22                  You are assuming LUEC I think at year 30  
23                  in your future options -- rather LSFCR at year 30. If  
24                  you knew now that it had to be done at year 15, for  
25                  example, I take it that the LUEC would go up.

1                   A. That's something that maybe you  
2                   should direct to Panel 10.

3                   Clearly, if you were to retube early in  
4                   life, then you are depreciating that amount of money  
5                   over the remaining life which may be, say, 20, 20 to 25  
6                   years. If you are retubing late in life, say at 30  
7                   years then you are depreciating that similar amount of  
8                   money over 10 years.

9                   I can't do in my head a comparison of  
10                  those two circumstances and say whether doing it  
11                  earlier in life means a larger percentage to levelized  
12                  unit energy cost.

13                 Q. In fact, for some of your units,  
14                  since the time of ONCI there has been an acceleration  
15                  of the date that you intent to do retubing, in some of  
16                  the your existing systems?

17                 A. There has been relatively small  
18                  changes in the life of the pressure tubes at Bruce "A",  
19                  but I don't believe there has been any change in the  
20                  life of Bruce Unit 3, that's still 25 years, and Bruce  
21                  Units 4, Pickering "B", 5, 6, 7, and 8, Bruce "B", 5,  
22                  6, 7, and 8 and Darlington are all up to 30 years. As  
23                  I explained in my direct evidence, the years that are  
24                  chosen to do the retubing are such that we will not  
25                  have two units at the same site or one station being



1 done at the same time. So I don't think I agree, other  
2 than small changes, with you.

3 Q. All right. In the next category the  
4 inquiry expressed its conclusions under is on page 93,  
5 discount rates and cost escalators. Would you agree  
6 with my summation that they point out that a lower  
7 discount rate favours high capital options like nuclear  
8 in a comparison, and that there are arguments for a  
9 higher social discount rate but they, in effect,  
10 declined to sit in judgment of that issue?

11 I am looking at the second paragraph  
12 under that heading.

13 A. I am afraid I cannot comment on  
14 social discounts rates. I am afraid I don't really  
15 know what that means.

16 But I would agree with you that if you  
17 calculate levelized unit energy cost with a discount  
18 rate of 4 per cent and you do the same calculation with  
19 6 per cent, you would get different answers.

20 Q. The higher the discount rate used,  
21 the more --

22 A. The higher the LUEC.

23 Q. The higher the LUEC.

24 A. Yes.

25 Q. For a project which has a high

1       upfront capital cost as opposed to one with costs  
2       spread out over time?

3                   A. Yes. And that's why in ONCI  
4       sensitivity tests on discount rate was done in the same  
5       way as capacity factors that we spoke of before the  
6       break.

7                   Q. You would agree with me that this  
8       is --

9                   THE CHAIRMAN: I should just point out  
10      that this whole matter was very, very extensively  
11      canvassed in Panel 2, and Mr. Cowan and others gave  
12      evidence about it.

13                  MR. D. POCH: Yes, Mr. Chairman, and I  
14      didn't propose to get into a discussion about discount  
15      rates and which one is appropriate here with Mr. Penn.  
16      I was just pointing out that the basis for the nuclear  
17      costing and ONCI's basis for the nuclear costing was  
18      taking the discount rate as given, though that inquiry  
19      did express the point that this was an important issue  
20      and they didn't venture into it. I can leave that  
21      point there.

22                  Q. Now, turning to the next category of  
23      nuclear station performance, they accepted what they  
24      described as convincing evidence to support an estimate  
25      of 80 per cent plant capacity factor for the 40-year

1 life span. And have I misunderstood something, Mr.  
2 Daly? I had thought that your evidence in chief was  
3 that you were no longer assuming 80 per cent as the  
4 median estimate.

5 MR. DALY: A. Again, for which period of  
6 time and units are we talking?

7 Q. Lifetime.

8 A. Well, on a lifetime basis for the "A"  
9 stations we are targeting 75, and for the "B" stations  
10 and Darlington 80 per cent we are targeting.

11 As I mentioned in my direct, yes, our  
12 current predictions are somewhat below that.

13 Q. Right. So you have a target.

14 A. Correct.

15 Q. And we will come to that in a minute,  
16 and you have a median projection and your current  
17 projection is below 80 per cent.

18 A. It varies from station to station.  
19 But generally speaking, the "A" stations we are  
20 currently projecting on a lifetime basis about 70 per  
21 cent of the "A" stations and close to 80 per cent for  
22 the "B" stations on a lifetime basis.

23 Q. Do you have the actual number for the  
24 "B" stations? For your projection, not your target.

25 A. The only projection that I have to

1 hand for the "B" stations, and this is just over the  
2 period 1992 to 2014, is 77 per cent for Pickering "B",  
3 and 79 per cent for Bruce "B". Those figures over the  
4 period 1982 to 2014 exclude our history and the history  
5 of both the "B" stations has been extremely good.

6 So, effectively we are saying on the "B"  
7 stations from the time of in-service, our current  
8 projection out to 2014 is to approximately 80 per cent.

9 In this particular reference here we are  
10 talking about a future station. So our evidence was  
11 that although we have had some performance decline on  
12 the "A" stations which has caused to us reduce our  
13 targets and forecasts there, the "B" stations  
14 performance to date and projected is good.

15 So the 80 per cent largely reflects the  
16 "B" station performance.

17 Q. All right. So then I take it you are  
18 projecting 80 per cent for Darlington?

19 A. For Darlington the only projection I  
20 have to hand is '92 to 2014, 78 per cent.

21 Q. 78 per cent, all right.

22 And for future station you would still  
23 project 80 per cent then?

24 A. I would still project 80 per cent  
25 based on the improvements we have seen in the later

1 designs and the improvements we would continue to plan  
2 for, for a future station.

3 Q. You refer to that as a median  
4 projection in your evidence in chief. I take it that's  
5 true for each of the numbers you have just given me?

6 A. Yes, yes.

7 Incidentally, these are the numbers that  
8 are consistent with the DSP Update.

9 Q. Yes. We will come to that in a  
10 moment, but we had noted an overall capacity factor  
11 implied by the materials provided for the Update that  
12 was somewhat lower.

13 I take it what we would be seeing is the  
14 averaging effect of the "A" stations, the "B" stations  
15 and any future that are included?

16 A. I'm sorry, I am not clear what --

17 Q. We had just taken - and we will come  
18 to this - but we had looked at the LMSTM outputs or  
19 inputs, and we had noted numbers in the mid 70s, and I  
20 take it that's the averaging effect of the lower "A"  
21 stations with the --

22 A. That's correct. In fact, I don't  
23 recall if I quoted you the "A" station values, -- no, I  
24 don't think I did because you didn't ask me for the "A"  
25 station values.



1                   The "A" station values, yes, when we plug  
2                   them in they bring the average of the whole system down  
3                   to about 75, 74/75 per cent. That's over the '92 to  
4                   2014 period, "A" stations, "B" stations and Darlington.

5                   Q. Now, if you turn to page 16 of our  
6                   materials. This came up earlier, and I wanted to get a  
7                   clarification here. We had taken you, and I guess this  
8                   would have been Panel 2, we had taken Mr. Snelson, I  
9                   guess, to this Interrogatory, 2.7.85, and you could see  
10                  we have excerpted the transcript at page 19 of our  
11                  materials.

12                  THE REGISTRAR: Exhibit 2.7.85 is .72.  
13                  ---EXHIBIT NO. 520.72: Interrogatory No. 2.7.85.

14                  MR. D. POCH: Q. First of all, if you  
15                  note at page 17, on the bottom line, capacity factor,  
16                  you had specified in the planning specification 80 per  
17                  cent for the Pickering "A", Pickering "B", and Bruce  
18                  "A", but there was no specification for Bruce "B" or  
19                  Darlington "B". Can I take it that if we look above on  
20                  Bruce "A" we see that there is a capability factor  
21                  there provided and the spread for Bruce "A" was five  
22                  points at that time.

23                  First of all, Mr. Daly, that spread for  
24                  Bruce "A" between capability factor and capacity  
25                  factor, that would have been before there was a concern

1 about locked-in power at Bruce; is that fair? At the  
2 time you would have planned Bruce "A" you wouldn't have  
3 been planning on a locked-in power situation?

4 MR. DALY: A. I am afraid I can't  
5 confirm that.

6 That is a rather high spread. A more  
7 typical spread would be 1 to 2 per cent.

8 Q. So then can we assume had you  
9 specified a capacity factor for Bruce "B" or Darlington  
10 it would have been somewhere between 80 and 84?

11 [12:30 p.m.]

12 A. Yes, I think that's a fair range.  
13 Yes.

14 Q. Now, we noted at the time to Mr.  
15 Snelson - of course, this is your area, which is why I  
16 am bringing it up again - the section we have  
17 underlined above that, where it's noted the values and  
18 specifications are meant to be challenging targets.

19 I take it that this answer about  
20 capability and capacity factors would have been  
21 prepared under your supervision, Mr. Daly, this is your  
22 area?

23 A. Part of it was prepared under mine  
24 and part of it was prepared by system planning because,  
25 you know, I am more familiar with the current situation

1 on the operating units and this interrogatory talked  
2 about the originally anticipated generation and so on,  
3 so we had to go back to system planning for the  
4 originally anticipated values.

5 Q. The discussion that occurred with Mr.  
6 Snelson at page 20 of our material, page 4398 of the  
7 transcript, Mr. Snelson indicated in response to Mr.  
8 Starkman's question about what is meant by challenging  
9 targets, and what we see at about line 17 is that the  
10 specification is prepared by the planning division and  
11 given to the design and construction branch to guide  
12 their design of the facility.

13 I take it those specifications were not  
14 your median performance projection of the day. Rather,  
15 they were challenging targets, as Mr. Snelson says,  
16 aimed in the direction of - adopting Mr. Starkman's  
17 words at line 10 - aimed high to set a challenging  
18 target.

19 Would you agree with that?

20 A. I would agree that these targets do  
21 differ from our median forecast. Our median forecast  
22 may be higher and it may be lower, depending on the  
23 particular period, the particular units we are looking  
24 at.

25 I have given you some examples where we

1 discussed some history where our median forecast, for  
2 example, for the "B" stations is higher, and we have  
3 seem some examples where the median forecast for the  
4 "A" stations is lower.

5 So I accept what Mr. Snelson is saying  
6 here as a specification to be used by the designers and  
7 later on the operators as appropriate, and if design  
8 and operations do a good job you can come in high on  
9 the specification; if you have problems you can come in  
10 lower on the specification.

11 Q. The point being though that they are  
12 set as challenging targets, not as median projections.  
13 You agree that as well?

14 A. I think the median projection would  
15 tend to follow that. First, you set the  
16 specifications, and then you decide whether your median  
17 forecast is going to be exactly that, higher or lower,  
18 and you will modify that as you gain experience in  
19 operating the plant.

20 Q. So your current projections with your  
21 current cost estimates for future stations are these  
22 kinds of specifications as opposed to median  
23 projections, is that fair, for the CANDU 3 and the  
24 CANDU 9 and the CANDU 6, for example?

25 A. I think in the case of the future

1 station our assessment at the time of ONCI, and remains  
2 today, is that 80 per cent is a reasonable median for  
3 the future station.

4 We would expect to see specifications --  
5 we have seen some of the specifications for some of the  
6 future plants which are slightly higher, and we  
7 indicated in ONCI a range around this, 75 to 80 per  
8 cent as I recall for the future station, and we think  
9 that still looks reasonable for a future station.

10 Q. Okay. Can we just look at Future  
11 Station Design, the comments under that heading at page  
12 94 of Exhibit 44. Back to the ONCI report.

13 MR. PENN: A. Yes, I have that.

14 Q. Now, Mr. Penn, it is noted there in  
15 paragraph 2 that the panel, the ONCI Panel, contacted  
16 the AECB to inquire after a list of outstanding safety  
17 issues which might shed light on the magnitude of  
18 future station design costs.

19 They obviously, I take it, could not get  
20 a list that goes out to with certainty 40 years, and  
21 they say:

22 There is uncertainty about design  
23 changes and associated capital  
24 expenditures that may be required during  
25 the decade preceding the future station's



1 assumed in-service date. Even more  
2 uncertainly exists about changes that may  
3 have to be made during the station's  
4 40-year life span.

5 We know of no way in which undefined  
6 future regulatory safety requirements can  
7 be quantified in terms of cost. However,  
8 such requirements can only increase  
9 costs, not lower them.

10 Would you agree, first of all, that they  
11 have recited the basis of the estimates you have  
12 provided, and would you agree with their observations?

13 A. Well, the first comment I would like  
14 to make is that in my knowledge they did receive a list  
15 of--

16 Q. Yes.

17 A. --issues from the AECB. That is not  
18 related to the second part of the subject.

19 I would agree that it is impossible to  
20 foretell the future to the extent that you know what  
21 the future costs are. The issue that arises is whether  
22 the provisions of future costs are reasonable. So it  
23 is a judgment.

24 Q. There is another observation they  
25 make, though, that there is an asymmetry about where

1 these costs can go. They say:

2 Such requirements can only increase  
3 costs, not lower them.

4 Perhaps you don't have to be that  
5 emphatic, but would you agree that it is not  
6 symmetrical?

7 A. I would agree that it is reasonable,  
8 given our recent past histories in this world, that  
9 costs are more likely to go up than down.

10 Q. And costs due to regulatory  
11 requirements are likely to go up as well?

12 A. Yes.

13 Q. Now, I understand that Energy Probe  
14 asked you for a list of all the ways that Pickering "A"  
15 would fail --

16 A. Maybe I should qualify that a little  
17 bit. Where you are repeating a design concept as  
18 opposed to a new one they are less likely continue to  
19 increase.

20 Q. All right. And I understand in  
21 Interrogatory 6.2.24, if my notes are correct, Energy  
22 Probe asked you to provide a list of all the ways that  
23 Pickering "A" would fail to meet the licensing  
24 requirement that was in fact applied to Darlington. I  
25 take it that Hydro refused to answer that

1       interrogatory. That is your understanding?

2               A. Well, I really don't know whether  
3       they refused or not. I would have to look up that  
4       interrogatory. I just can't remember all of them by  
5       number.

6               Q. That's fine. Perhaps we will just  
7       give it a number so it will appear on the record.

8               THE REGISTRAR: 6.2.24 will be .73.

9       ---EXHIBIT NO. 520.73: Interrogatory No. 9.2.24.

10              MR. DALY: Excuse me, Mr. Poch. Is that  
11       a 6, a 6 or a 7?

12              MR. D. POCH: Q. It is a 6.

13              MR. DALY: A. It is a 6. All right.

14              Q. That's why I questioned whether my  
15       notes were accurate, to be frank. We will see if we  
16       can find it, too.

17              In any event, Mr. Penn, perhaps in a  
18       little more generalized way then, it is certainly true,  
19       is it not, that the AECB has added numerous  
20       requirements, some quite expensive, to subsequent  
21       generations of reactors as you have built, and there is  
22       quite a difference between Pickering and Darlington,  
23       and some of that difference is because of AECB  
24       requests?

25              MR. PENN: A. There is no doubt that as

1 the regulatory process and understanding of nuclear  
2 safety has evolved that the requests have increased.

3 One of the fundamental issues in nuclear  
4 power in the future and the importance of  
5 pre-engineering and the importance of what is happening  
6 in the United States on what is called one-step  
7 licensing, and here in Canada where AECL, for example,  
8 is asking for a preview by the AECB is to ensure that  
9 to the largest extent possible prior to construction  
10 that the issues with regard to regulatory safety are  
11 largely settled.

12 Q. But you don't have an AECB preview of  
13 the next 4 by 881, do you?

14 A. Well, no, because the government  
15 decided that there should be a nuclear moratorium.

16 Q. Yes.

17 A. We would have done, but we don't  
18 because of that.

19 Q. In fact, if you did that wouldn't one  
20 of the effects be that we would tend to lock in the  
21 design and the regulatory thinking to some extent  
22 earlier than we do in the current licensing process?

23 A. Well, yes, but if there was any  
24 significant issue that came up in ongoing research and  
25 development that clearly was the subject of safety

1 concerns I am quite sure that it would have to be taken  
2 care of.

3 Q. Well, if it was a minor matter I  
4 think I might agree with you, but wouldn't you agree if  
5 it is a major rethinking that would mean perhaps  
6 scrapping a whole project which is already well along,  
7 and there would be a large cost involved in that?

8 A. I think that is speculative. If  
9 there was a major change it wouldn't necessarily mean  
10 scrapping the whole plant.

11 Q. So you have just said, then, that if  
12 there were changes in regulatory thinking you  
13 presumably in that scenario would have to meet those  
14 changes even though you had gone through some kind of  
15 pre-engineering and regulatory assessment. So if that  
16 is the case, then, you wouldn't avoid this cost  
17 escalation due to regulatory escalation?

18 A. Well, you would to a considerable  
19 extent because you wouldn't expect a wholesale series  
20 of changes during construction when you spent three or  
21 four years in going into every detail of the design.  
22 It doesn't sound credible to me that you could do all  
23 that and then still find yourself having made no  
24 improvements or progress in both sides assuring  
25 themselves of safety.



1 Q. I sense we may be talking at  
2 cross-purposes here. It seems to me that what I am  
3 talking about is the progression over time of the  
4 regulators' insight and requirements, which creates new  
5 requirements, which increase cost, and I think you are  
6 talking about the costs of the regulatory process  
7 itself and ways to streamline that.

8 Let's leave aside the streamlining of  
9 regulation for a moment.

10 A. No, I was talking about any changes  
11 in design of a particular plant. I wasn't talking  
12 about a change in a process.

13 Q. Well, Mr. Penn, you have agreed with  
14 me, have you not, that there has been a progression of  
15 requirements by the safety regulator over time as we  
16 learn more?

17 A. Well, yes, because there has been an  
18 evolutionary development of nuclear energy over the  
19 last 35 years.

20 Q. Around the world, in fact?

21 A. Yes.

22 Q. And the AECB is cognizant of  
23 developments around the world?

24 A. Yes. And I kind of hope that after  
25 all that time and after all that effort that we have

1 now got a pretty good understanding of what is  
2 required.

3 Q. Well, sometimes O-rings fail on  
4 Challengers, too, Mr. Penn, and you would expect a  
5 regulator, when they become aware of a problem, to do  
6 something about that problem?

7 A. Well, absolutely, but I don't expect  
8 progressive changes in regulation in a product that is  
9 close to maturity.

10 Q. So you would expect to see a tapering  
11 off then of this progression of requests over time?

12 A. Well, it is a personal view, but I  
13 would expect to see continuing vigilance because safety  
14 is paramount for everybody, but I wouldn't expect to  
15 see in a developed engineering design a continual  
16 progression of regulatory change at the same rate as in  
17 the past. That is a personal view, but that is how I  
18 see it.

19 Q. Your cost estimates and the ones you  
20 gave to ONCI, then, do not assume a continuation of the  
21 escalation in safety requirements that we have  
22 witnessed to date? That is what you are saying to me?

23 A. In contrary, they assumed the same  
24 expenditure as would occur on Darlington station to the  
25 time that ONCI occurred--

1 Q. Right.

2 A. --in '88.

3 Q. They do not assume a new layer of  
4 requirements requiring new systems, for example, added  
5 on to the Darlington design to meet new safety  
6 concerns?

7 A. Well, I don't know whether you can  
8 say that or not because clearly if you are repeating a  
9 design and you have spent a large amount of money in  
10 settling a number of issues and then you assume that I  
11 am going to spend exactly the same money in constant  
12 dollars, not dollars of the year, so it has the same  
13 value on a future 4 by 881, it seems to me that you  
14 have the benefit of the past and you have taken care of  
15 any changes in the future, at least in a reasonable  
16 way.

17 Q. Mr. Penn, what it seems to me you  
18 have done is locked in the assumptions that pertain to  
19 Darlington, and you have ignored the possibility that  
20 over the intervening 10 or 20 years the AECB may come  
21 up with some new concerns --

22 A. No, we haven't at all.

23 THE CHAIRMAN: Just a moment. Just a  
24 moment.

25 I think this is getting to be

1 argumentative. I think the position Mr. Penn is taking  
2 is quite clear and that you don't agree with him is  
3 also clear, and I don't think you need to pursue it any  
4 further.

5 MR. D. POCH: Mr. Chairman, I am still a  
6 little unclear on what Mr. Penn has said. I can  
7 understand we may differ on whether he should assume --

8 THE CHAIRMAN: If you want to ask some  
9 questions to clarify what he said, that is fine, but  
10 there is no purpose gained in getting into an argument  
11 with him.

12 MR. D. POCH: Fair enough, Mr. Chairman.

13 Q. Mr. Penn, then, to clarify, you have  
14 taken the level of regulatory requirement on Darlington  
15 and assumed it is going to be the same for the CANDU  
16 "A" in 2010?

17 MR. PENN: A. We assumed, and it is  
18 stated very clearly in ONCI and I can't tell you  
19 exactly where to look, but it states in ONCI that the  
20 same level of effort with regard to satisfying  
21 regulation and protecting public safety would be  
22 assumed for the 4 by 881, if we ever build one in the  
23 future, compared to Darlington.

24 Q. If we just take the example sort of  
25 Pickering generation to Darlington generation where --

1 obviously, an early example, we have heard evidence  
2 that you had to add a second fast shutdown system, for  
3 example? You have not assumed in your future station  
4 costs added requirements of that nature, not  
5 necessarily a fast shutdown system but of that nature,  
6 new layers of safety because of a new understanding  
7 about risk?

8 A. Well, we can't define what we don't  
9 know that might occur in the future, but I would say to  
10 you that the amount of money spent on safety analysis  
11 and discussions with the AECB and, if you like, meeting  
12 regulation on Darlington was far higher than any  
13 previous station we built.

14 Q. All right. And we will return a  
15 little later to this question. I will discuss with Mr.  
16 King about where we are headed in terms of our  
17 understanding of safety and how that may reflect on  
18 this discussion. So let's leave it there for a moment.

19 ONCI agrees at the top of page 95 not to  
20 include -- agree with Hydro's position, they say, that  
21 tax funded research and development costs should be  
22 excluded from the future station cost estimates.

23 Let's just try in posing this question to  
24 think about two different kinds of investments in R&D,  
25 some that were tax funded and are sunk, and some that



1 might be continuing in the future.

2 Mr. Penn, would you agree that, though  
3 they may be beyond your control future, avoidable tax  
4 funded R&D is a societal cost which is a cost of  
5 nuclear power?

6 [12:50 p.m.]

7 A. Yes.

8 THE CHAIRMAN: You say avoided tax funded  
9 R&D?

10 MR. D. POCH: Future avoidable tax funded  
11 R&D, and I am saying R&D specific to nuclear, of  
12 course.

13 MR. PENN: I suppose I should ask you  
14 what you mean. Do you mean that Hydro would pay for  
15 all R&D? Is that how we are avoiding taxable R&D?

16 MR. D. POCH: Q. No. I guess I am just  
17 asking a simpler question.

18 If we want to take the total cost of  
19 nuclear power from a societal perspective, first of all  
20 you would agree it matters not who pays for the R&D by  
21 definition if we are taking the societal perspective?

22 MR. PENN: A. I think I agree.

23 Q. All right. I am just saying to the  
24 extent that R&D may occur in the future, or continues  
25 to occur, to the extent that that could be cancelled is

1       avoidable if we chose not to pursue the nuclear option.  
2       Would you agree that that is a cost of the nuclear  
3       option that should be counted in a societal tallying up  
4       of nuclear costs?

5               A. I would agree that we have a national  
6       Canadian nuclear R&D program and that Ontario benefits  
7       from that program to likely a greater extent than other  
8       parts of the country, if that answers the question.

9               Q. Well, I think you have agreed, have  
10      you not, that from a societal perspective, in tallying  
11      up the costs of nuclear, then you would want to capture  
12      those costs to the extent that they may be avoidable.  
13      Can you agree with that?

14              A. Well, they could be captured, but we  
15      do national R&D for the good of the nation, for export,  
16      for encouraging our industry, for a whole economic  
17      series of reasons. This is out of my line of field to  
18      know what benefit it is specifically to Ontario's  
19      nuclear program.

20              Q. Moving on to capital costs. Can I  
21      paraphrase ONCI to say that they accept your estimates  
22      and they note they are based on past experience,  
23      especially Darlington. In general the report is based  
24      predominantly on your experience with Darlington?

25              A. Well, a capital cost estimate in ONCI

1 was used, the Darlington cost as the base. And the  
2 update that we have given in this hearing, which we  
3 referred to I believe yesterday --

4 THE CHAIRMAN: Is that the preliminary  
5 review you are referring to?

6 MR. PENN: No, it was a document that was  
7 in CNA's material.

8 MR. D. POCH: Q. So that would be the  
9 first document behind tab 2, which forms part of  
10 Exhibit 520.29?

11 MR. PENN: A. That's correct, yes.

12 Unfortunately, I don't have the exhibit  
13 number on this marked down here, but it was  
14 Interrogatory 9.2.118 and the document I have just  
15 referred to is entitled: Cost Update for Future 4 by  
16 881 Megawatt CANDU Nuclear Generating Station, An  
17 Update of ONCI Chapter 16 and 36, Exhibit 43.

18 What that document does is it takes into  
19 account basic increases in Darlington since 1988 that  
20 would be expected to be similarly associated with a new  
21 4 by 881 megawatt in the future, recognizing that  
22 clearly we would have learned from our generator rotor  
23 problem and that we certainly wouldn't repeat a problem  
24 with the primary heat transport circuit.

25 Q. If we just look table 1, which

1 appears on page 3 of that material, do you have that?

2 A. Yes, I have table 1.

3 Q. All right. And what you have done  
4 there is you have taken the first column which is what  
5 you gave as reported in ONCI, you brought it to 1991  
6 cents per kilowatthour to be a consistent basis with  
7 your current estimate in the second column?

8 A. Yes, retaining the in-service date of  
9 2002.

10 Q. And so one of the differences between  
11 the set of columns, the second set of columns and the  
12 third set of columns is the in-service date. And I  
13 take --

14 A. Plus these other changes in the base  
15 cost of Darlington.

16 Q. And those changes are recited on page  
17 2 at the top; is that right? These are changes which  
18 you indicate have a potential for reducing capital  
19 costs?

20 A. Those lists from A to J are the  
21 results of studies we did prior to the nuclear  
22 moratorium on new plant in our schedule cost reduction  
23 study, which we did not credit in the costs given in  
24 table 1 at all

25 The changes in costs are given in table

1 2, those being that the levelized unit energy cost has  
2 increased by 8.9 per cent because of capital cost  
3 increases seen in Darlington, that in our judgment  
4 wouldn't necessarily be avoided next time, and a 2 per  
5 cent increase in OM&A which is the result of the level  
6 of OM&A expenditures that we have an increased to since  
7 1988, and a reduction in fueling costs due to obtaining  
8 fuel, uranium in the future from Saskatchewan, and  
9 secondly, the used fuel disposal facility in-service  
10 date changing from 2015 to 2025. So the net increase  
11 in LUEC is 7-1/2 per cent.

12 THE CHAIRMAN: I am not sure I  
13 understand. Looking at table 1 you have in the first  
14 set of figures as reported in ONCI and the second set  
15 is ONCI assumptions in-service 2002, current economic  
16 indices, and then the percentages of the various costs  
17 change. Is that because of the in-service date change?

18 MR. PENN: It's partly, Mr. Chairman, but  
19 it's also partly due to changed economic indices in the  
20 future.

21 THE CHAIRMAN: And then the third set of  
22 figures incorporates your Darlington experience to  
23 adjust the costs again. Is that the way it is done?

24 MR. PENN: Yes, and a further change in  
25 the in-service date to 2005 from 2002.



1 THE CHAIRMAN: All right.

2 MR. PENN: This is all summarized in a  
3 very simple way in the introductory comments on page 1.  
4 I will just read from the second small paragraph:

5 The updated levelized unit energy  
6 costs of 3.7 cents per kilowatthour in  
7 '91 dollars replaces the LUEC of 3.0  
8 cents in 1988 dollars reported in ONCI.  
9 The 1988 ONCI value is equivalent to 3.5  
10 cents per kilowatthour in '91 dollars.

11 So that, in essence, the real increase in  
12 LUEC due to the changes that are shown in table 2 are  
13 .2 cents per kilowatthour, the other differences being  
14 changes in economic indices.

15 THE CHAIRMAN: All right.

16 MR. D. POCH: Q. First of all, I'm  
17 sorry, the percentage expressed in table 2 there are  
18 percentages of the total LUEC, not of the sub item.  
19 So, for example, capital cost, 8.9 per cent, that's the  
20 effect it has on total LUEC, the change, as opposed to  
21 just on the sub amount?

22 MR. PENN: A. That's correct.

23 Q. It would be a higher figure as  
24 expressed as a percentage of capital cost?

25 A. I think it would be.

1 Q. And if we turn in Exhibit 44, the  
2 ONCI report, to page 26, we see a discussion of capital  
3 cost there. Mr. Penn, dry capital cost is the dominant  
4 cost for nuclear; correct?

5 A. This is an exhibit 43, is it?

6 Q. 44, which is the ONCI report.

7 A. Page 26, thank you.

8 Q. Yes.

9 A. The dry capital cost is the dominant  
10 cost, yes.

11 Q. About two-thirds of your LUEC?

12 A. Well, I think in my testimony --

13 Q. You said 63.8 at page 62 for initial  
14 capital as opposed to 72.7 total capital.

15 THE CHAIRMAN: If you are looking at  
16 table 1, that's not the figure -- am I wrong to look at  
17 table 1 to see what the percentage is?

18 MR. D. POCH: I'm sorry, Mr. Chairman?

19 THE CHAIRMAN: Table 1 of this recent  
20 update.

21 MR. PENN: I think that's an excellent  
22 indication.

23 THE CHAIRMAN: It says it was 48 per cent  
24 back in ONCI days, 49 per cent, now it's 58 per cent.

25 MR. D. POCH: All right.

1 Q. Mr. Penn, perhaps you can just  
2 reconcile for us then those figures and the ones you  
3 have given us at page 62 of Exhibit 519.

4 THE CHAIRMAN: Could we stop now and  
5 adjourn until 2:30?

6 MR. D. POCH: Yes, thank you.

7 THE REGISTRAR: Please come to order.  
8 This hearing will adjourn until 2:30.

9 ---Luncheon recess at 1:03 p.m.

10 ---On resuming at 2:30 p.m.

11 THE REGISTRAR: This hearing is again in  
12 session. Be seated, please.

13 MR. D. POCH: Mr. Chairman, earlier today  
14 I referred to an Energy Probe interrogatory 6.2.24 and  
15 it was assigned No. 520.73. I am informed that the  
16 proper interrogatory reference is to 9.2.24.

17 So perhaps Exhibit 520.73 should remain  
18 the number and it would assigned to 9.2.24.

19 THE CHAIRMAN: Do you have that, Mr.  
20 Lucas?

21 THE REGISTRAR: Yes, I have that.

22 MR. D. POCH: Q. Gentlemen, we were  
23 about to look at the Ontario Nuclear Cost Inquiry's  
24 considerations with respect to capital cost, and I had  
25 put a number in your mouth, Mr. Penn, of what capital

1 costs represent as a per cent of total LUEC and I said  
2 variously 72.7 for total capital and 63.8 for initial  
3 capital and the Chairman noted a different number in  
4 the material provided in table 1 of Exhibit 520.29.  
5 And he noted a number in the range of 48 or 54.

6 Can we just make sure we are all talking  
7 about the same thing here?

8 MR. PENN: A. Yes, thank you, Mr. Poch.

9 We were referring to page 62 of Exhibit  
10 59 and Mr. Poch had noted the initial capital cost was  
11 63.8 per cent of total levelized unit energy costs.  
12 And table 1, if you look in the third double column,  
13 and below the first horizontal line you will see to the  
14 left, total initial capital costs, and in the third  
15 column you will see the same number, 63.8 per cent. I  
16 think probably, Mr. Chairman, you had picked up the dry  
17 capital cost.

18 THE CHAIRMAN: No, I picked up the total  
19 capital cost. That was the modifications,  
20 decommissioning and --

21 MR. PENN: I see. Yes, sir, I  
22 understand.

23 THE CHAIRMAN: I was looking at it too  
24 quickly.

25 So 63.8 is the figure that we are talking

1 about.

2 MR. PENN: Yes, and it is it's the same  
3 number as in my direct evidence.

4 MR. D. POCH: Q. Mr. Penn, just to be  
5 completely clear then. That is up from the 54.2 as  
6 reported in ONCI, which when expressed in '91 dollars  
7 with new escalators, I assume, it would be 60.5?

8 MR. PENN: A. That's correct, Mr. Poch.  
9 And the reason, of course, that those numbers have an  
10 increased from 54.1 to 57.9 is because, as it's  
11 explained in table 2, the major increase is in the  
12 capital component and we have an offsetting component  
13 in fueling costs.

14 Q. I understand that, and I was actually  
15 just looking at the different, just in moving it from  
16 88 cents per kilowatthours, the ONCI numbers, to the  
17 same ONCI numbers expressed in '91 cents per  
18 kilowatthour, I was intrigued that total initial  
19 capital cost went from 54.2 per cent to 60.5 per cent.

20 THE CHAIRMAN: Where are we looking now?

21 MR. D. POCH: Q. I am looking at the  
22 first two sets of columns, first two pairs of columns  
23 under per cent total, total initial capital, and it was  
24 54.2 in '88 cents per kilowatthours as reported in  
25 ONCI, and then the ONCI estimates with the same



1 in-service, 2002, as ONCI assumed, but expressed in '91  
2 cents per kilowatthour, 60.5 per cent, and so that's  
3 what I was looking at.

4 I take it then there is more going on  
5 there than simply a change in the dollars we are  
6 expressing, because we have seen a change in the  
7 composition of the costs, and is that due to changed  
8 assumptions about escalators?

9 MR. PENN: A. Well, that's the only  
10 change that it should be due to.

11 There aren't any changes in the design  
12 estimated costs between the first two double columns.

13 DR. CONNELL: It could be a change in the  
14 discount rate between '88 and '91.

15 MR. PENN: Well, there certainly is, Dr.  
16 Connell.

17 DR. CONNELL: That might affect the  
18 percentage figures.

19 MR. D. POCH: Yes. And I should have  
20 been clear, escalators and discount rate of course both  
21 are used to go forward and back. You don't use one  
22 without the other.

23 THE CHAIRMAN: Wasn't the in-service date  
24 changed, too?

25 MR. PENN: No, sir.

1 THE CHAIRMAN: It wasn't.

2 MR. PENN: Not that I recall.

3 The median estimate in ONCI, I think, was  
4 2003.

5 I didn't personally calculate these  
6 numbers so I can't offer any more advice on them than  
7 what I have.

8 MR. D. POCH: Q. What I am suggesting  
9 then is, the change we have seen, for example, in total  
10 initial capital, to your -- I'm sorry, moving from ONCI  
11 to your current estimate, you have expressed it here as  
12 being the change, for example, 60.5 to 63.8, but there  
13 in fact has been another and significant change due  
14 different assumptions about, we can presume, escalation  
15 and discount rates, amongst other things.

16 MR. PENN: A. Yes. Well, as I mentioned  
17 before lunch, if you go to the introduction passage and  
18 look at the second paragraph, you will note that in  
19 changing from '88 dollars to '91 dollars and with the  
20 necessary financial indices changing, one or another,  
21 that is worth -- let's put it this way, the 1988 ONCI  
22 value is equivalent to 3.5 cents per kilowatthour in  
23 1991 dollars, so it's worth half a cent.

24 [2:40 p.m.]

25 Q. All right. While we are on this

1 table, Mr. Penn, just looking at the bottom line, just  
2 leaving aside the change between the two reported ONCI  
3 estimates, one in '88 and one in '91, just looking at  
4 the change between the ONCI expressed in '91 dollars  
5 and your current estimate, you show a 7-1/2 per cent  
6 increase, and that is with the change of in-service of  
7 three years, from 2002 to 2005?

8 A. Well, it is that plus the increase in  
9 cost, the base cost of Darlington--

10 Q. Right.

11 A. --that we have noted below of another  
12 8.9 per cent equivalent on LUEC.

13 Q. Yes, you have netted out the various  
14 changes below, and that accounts for the full 7-1/2 per  
15 cent, and I am wondering where the 1 per cent per year  
16 we would expect to see from your earlier ballpark scale  
17 you provided us, because I would have assumed there  
18 would be 3 per cent just because of the change in  
19 timing.

20 A. Well, 3 per cent of 3-1/2 is .09.

21 Q. Well...

22 A. Or is it .009?

23 Q. Well, I just assumed, Mr. Penn --

24 THE CHAIRMAN: 3-1/2 being the LUEC  
25 figure, is that what you are saying?

1 MR. PENN: Yes, and would you take 1 per  
2 cent per year for the in-service of -- about .8 per  
3 cent actually, per year for three years. So it is like  
4 2.4 per cent of 3.47, and 2.4 per cent of 3.47 is about  
5 .06, I think. Isn't it?

6 MR. D. POCH: Q. So, Mr. Penn, are you  
7 saying --

8 MR. PENN: A. Sorry. It's the second  
9 decimal figure we are looking at.

10 Q. You are saying that round off, what  
11 have you, it is included in the 7-1/2 per cent?

12 A. Oh, yes. Now, these have been  
13 calculated using the full computerized model that  
14 system planning has developed. I gave you a rule of  
15 thumb that allowed you to avoid doing that sort of  
16 calculation.

17 Q. Okay. I appreciate that. I am just  
18 noting then that for this three year change and because  
19 of whatever we have learned in the three years since  
20 the ONCI estimates, three or four years--

21 A. Yes.

22 Q. --the total change amounts to 7-1/2.  
23 So the rule of thumb, if you will, has been exceeded by  
24 more than 100 per cent in this instance?

25 A. Well, the rule of thumb only applies

1 to a change in the in-service date per year--

2 Q. Yes?

3 A. --assuming no other change--

4 Q. Yes.

5 A. --in the situation at all.

6 Q. I understand that. So that is what I  
7 want to clarify. Your rule of thumb doesn't take into  
8 account changes in scope, changes in assumptions?

9 A. Not at all.

10 Q. It's just the timing effect?

11 A. Exactly.

12 Q. Now, looking at this initial capital  
13 item, which we have agreed is the majority of cost, and  
14 looking at what ONCI said about it, they look at this  
15 starting at page 26 of their report. Perhaps you could  
16 turn that up? This is page 26 of Exhibit 44.

17 A. Yes, I have that.

18 Q. And if we just look at the initial  
19 capital cost, Dry, which is the first figure roughly  
20 half the cost of your LUEC--

21 A. Yes. It is just a little more than  
22 half, actually.

23 Q. Right. --they accepted your  
24 suggested or maybe they altered but they took a 13 per  
25 cent reduction from the then current estimate for



1       Darlington. I am looking at the bottom of page 27  
2       here. You assumed in your submission to them, I think  
3       it is fair to say, that you would reduce costs by 13  
4       per cent from the then current estimate of Darlington?

5               A. That was correct, and it was a  
6       function of pre-engineering, it was a function of  
7       constructibility changes, it was a function of using a  
8       computerized, three-dimensional data bases, and  
9       changing work schedules and many other things.

10              Q. All right. In fact, Mr. Penn, they  
11       help us here a little bit. The paragraph above that  
12       refers to:

13                      For the existing site Hydro estimates  
14                      a reduction of five per cent in permanent  
15                      materials costs due to design  
16                      standardization, control of changes  
17                      during construction, and reductions in  
18                      construction material.

19              In fact, though, Mr. Penn, to the extent  
20       we are now talking about something other than another  
21       Darlington 4 by 881 some of that economy wouldn't be  
22       there, fair? We wouldn't be looking at a standardized  
23       design that you have constructed?

24              A. Are you talking about other options  
25       other than 4 by 881?

1 Q. Yes. Yes, that's right.

2 A. They certainly wouldn't--

3 Q. All right.

4 A. --be able to attribute the same type  
5 of cost savings, no. But they have different  
6 characteristics.

7 Q. And they said of the 13, 8 per cent  
8 is due to estimated productivity gains. Is that on the  
9 assumption that as you build more similar units you can  
10 speed up the process?

11 A. Well, they are referring to some 70  
12 constructibility studies that we performed in the  
13 schedule cost reduction study. For example, one of the  
14 major ones was the way we would build the vacuum  
15 building if we built a 4 by 881 again, and we found  
16 approaches that would save significant time and money.  
17 So this being classed as a productivity gain, for  
18 example.

19 Q. Just harkening back to the 5 per cent  
20 for a moment, they refer to control of changes during  
21 construction. Could you tell me what a jumper is?

22 A. I'm not sure where it is referred to.

23 Q. They don't refer to it, and I was  
24 asking you what the term means.

25 A. Oh. Well, would you like to...

1 I think Mr. King can explain that fully.

2 Q. Mr. King?

3 MR. KING: A. It is a temporary change  
4 in design or it is a permanent change which has not yet  
5 gone through the full process of being built and all  
6 the drawings updated to reflect as built.

7 Q. So the jumper is actually the  
8 temporary documentation reflecting a change in design  
9 that has yet to be sort of typeset and put in a binder,  
10 if you will?

11 A. There is a whole book, a jumper  
12 record book, which keeps track of all these temporary  
13 situations.

14 Q. All right. Would you turn with me to  
15 Exhibit 525, which is Nuclear Power Hazard Report, it  
16 has been styled and the subtitled is, A Review of  
17 Ontario Hydro and AECB Information on Selected Hazards  
18 at Ontario Hydro's CANDU Nuclear Generating Stations.  
19 I don't think you or the AECB used the word "hazard".  
20 That's ours.

21 Do you have that, Mr. King?

22 A. Yes.

23 Q. I am going to take you to page 19.

24 Now, I am taking you here at this time  
25 really just to get the numbers, but in fairness to you

1 the comment is made in leading up to these numbers that  
2 the AECB has expressed significant dissatisfaction with  
3 the maintenance situation and the number of jumpers, is  
4 that fair, that they have been dissatisfied with that?

5 A. You are reading from the --

6 Q. I am actually reading from the prior  
7 page, the lead-in.

8 A. Page 19?

9 Q. At the bottom of page 19, yes.

10 THE CHAIRMAN: Would you read that again,  
11 please? I am just not sure I can find...

12 MR. D. POCH: Under 2.1, Maintenance.

13 THE CHAIRMAN: What page?

14 MR. D. POCH: Page 19 of Exhibit 525.

15 THE CHAIRMAN: I'm sorry, I was looking  
16 at...

17 MR. KING: Which sentence were you  
18 referring to?

19 MR. D. POCH: Q. Basically, the general  
20 thrust of the paragraph -- and I am not asking you to  
21 necessarily agree with every sentence, but the basic  
22 thrust of the paragraph is that the AECB has been  
23 quite dissatisfied with the maintenance situation as  
24 evidenced by the number of jumpers, and that  
25 dissatisfaction extends into 1991?

1                   MR. KING: A. In some of the AECB's  
2                   annual reports on various stations they have expressed  
3                   in the past some dissatisfaction with jumpers, with the  
4                   number of jumpers.

5                   Q. right. This report, Mr. Chairman, it  
6                   is actually a background piece to assist some of our  
7                   experts who are preparing much more detailed analyses,  
8                   but - and this is really almost a survey piece - but it  
9                   looked at '89 and 1990 occurrences and information from  
10                  the record that was available.

11                  So, Mr. King, in the last year that this  
12                  report analyzed, 1990 -- or I'm sorry, for the two  
13                  years it noted that Darlington had over 2,000 jumpers,  
14                  as many as for the other four stations combined.

15                  So would you agree that the great many  
16                  jumpers there are indicative of a significant number of  
17                  design changes?

18                  A. No, that is not indicative of that at  
19                  all. You have to understand how they use jumpers in a  
20                  station which is under construction.

21                  If I could give you a good example from  
22                  Darlington is when you are bringing on units, let's say  
23                  Units 3 and 4 right now. Prior to them being critical  
24                  one of the things you do in commissioning a control  
25                  room, for example, and you have a sequence of events



1 recorder in the control room, which is computer-driven,  
2 which takes signals from throughout the plant, various  
3 alarms, status of electrical equipment throughout the  
4 plant, when you are commissioning that computer you  
5 don't want it to be in an alarm state all the time.

6 In fact, you have not finished the  
7 construction of some of those aspects of certain  
8 systems which would ultimately lead to an alarm in the  
9 sequence of events computer.

10 So while you are still building those  
11 systems you jumper out those inputs to that computer  
12 because you don't want to be in an alarm state all the  
13 time. So in fact that one reason at Darlington for  
14 each of the stations not yet fully in-service--

15 Q. Each of the units.

16 A. --would lead to 10s of dozens of  
17 jumpers, and it has nothing to do at all with the state  
18 of design changes. It has not been fully built yet and  
19 they jumper out certain things to allow construction to  
20 proceed.

21 Q. Mr. King, the AECB wouldn't be  
22 worried about that kind of jumper, would they? They  
23 would understand that is a necessary jumper and truly a  
24 temporary one for a temporary design change?

25 A. I am not aware of the AECB being

1 dissatisfied with the number of jumpers at Darlington.

2 Q. All right. Are you aware of them --  
3 as I think you just gave evidence, they were  
4 dissatisfied with the number of jumpers in past years.  
5 Are you aware of them being dissatisfied with the  
6 number of jumpers at your other units?

7 A. Well, as I think I indicated, I am  
8 aware in some past some AECB annual reports that they  
9 have indicated dissatisfaction with the number of  
10 jumpers at some stations.

11 Q. And there are hundreds of jumpers at  
12 these other stations according to this report in the  
13 '89/90 time frame.

14 A. Oh, no. I was just referring to --  
15 you brought up the subject of Darlington, suggesting as  
16 in this Exhibit 525 that is it is indicative, as it  
17 says in here, of the degree of start-up problems  
18 experienced at Darlington, and I am saying that is not  
19 true at all.

20 Q. What are all the hundreds of jumpers  
21 that the AECB has expressed dissatisfaction about at  
22 the other stations? Are they just temporary changes to  
23 accommodate testing, or are they jumpers evidencing  
24 changes in design which have yet to be formally  
25 incorporated in the documentation?

1                   A. I gave you a description of those two  
2 types of two classes of jumpers.

3                   Q. Yes.

4                   A. And yes, by definition they could be  
5 temporary changes or changes which are permanent but  
6 not yet fully into the whole documentation system.

7                   Q. Of the 2,000 or so jumpers there with  
8 respect to Darlington, approximately how many of those  
9 would be for changes in the design that aren't of the  
10 category you just spoke about, these temporary testing  
11 jumpers?

12                  A. Oh, I have absolutely no idea. I  
13 know there is a large--

14                  Q. Would it be --

15                  A. --number of them--

16                  Q. Would it be --

17                  A. --in the category that I --

18                  THE CHAIRMAN: Just let him finish,  
19 please.

20                  MR. KING: --a large number of them in  
21 the category similar to what I described.

22                  In fact, when you are building multi-  
23 unit stations and you have some common services  
24 throughout those four stations, typically if you are  
25 running two and two of them aren't running, and let's

1 go to another example of a piping system, you have to  
2 blank off the piping such that you can maintain a  
3 pressure integrity on the operating stations, a blank,  
4 a physical, metal blank which is inserted into a piping  
5 system, that is a jumper.

6 MR. D. POCH: Q. I appreciate that, and  
7 you have made that point well, and I am asking you now  
8 are we talking about -- of the kind of jumpers we are  
9 concerned with here - that is, jumpers evidencing a  
10 change in design - are we talking about there being a  
11 handful or are there 10s or dozens or are there as many  
12 as a hundred perhaps at Darlington?

13 MR. KING: A. A hundred in what  
14 category?

15 Q. In the category of changes to design.

16 A. I would assume that there would be --  
17 if you want to use the word -- I wouldn't be surprised  
18 if there was a hundred, but the hundred changes in  
19 design may well be very minor--

20 Q. Fair enough.

21 A. --changes in design.

22 Q. Mr. Penn, that is your understanding,  
23 that there could easily be in excess of 100?

24 MR. PENN: A. I don't think I have the  
25 knowledge to tell you, Mr. Poch.

1 Q. All right.

2 MR. DALY: A. I think, Mr. Poch, you  
3 could get a feel for that number by the difference  
4 between the Darlington number and the numbers shown for  
5 the other stations, the mature operating stations.  
6 That gives you a feel for those that are unique to the  
7 start-up condition.

8 Q. And just to be clear, then, that is  
9 the difference between the 2,000 figure for Darlington  
10 and the figures offered there for the others ranging  
11 from 246 up to 1,081?

12 A. That has been a typical sort of  
13 experience. As Mr. King says, when we start up a  
14 station there is typically a large number of jumpers  
15 placed during the construction process, and we would  
16 expect it to come down to values typical of a mature  
17 station.

18 Q. And just so we understand, if there  
19 are these values typical of a mature station, which are  
20 in the several hundreds, if I can --

21 A. Typical but not satisfactory to us.  
22 We are still trying to get these values lower also.

23 Q. And if there are say, for example,  
24 246 such jumpers outstanding at Pickering "B", that  
25 isn't the sum of all jumpers over the life of that



1 station to date; that is how many happen to be  
2 outstanding right now and there may have been other  
3 generations of jumpers, if you will, that you have  
4 satisfactorily incorporated in your documentation?

5 A. That's correct.

6 Q. All right. And those would tend to  
7 be of this category "design changes" as opposed to the  
8 other category that Mr. King was talking about?

9 A. I couldn't give you an exact split,  
10 but some would be typically -- if you are making a  
11 change, the change is put in on all four units. So  
12 there is a period of time until the change is fully put  
13 in on all four units, and during that period of time  
14 the jumpers are placed.

15 Q. Okay. And so I take it from your  
16 evidence, Mr. Daly, that this is an ongoing process,  
17 that there are constantly design changes being made,  
18 some minor, some affecting only one unit, some  
19 affecting more, and that it is not a one-to-one  
20 relationship with the jumpers, but that is a kind of an  
21 index which demonstrates how that carries on through  
22 time?

23 A. Well, there are design changes on an  
24 ongoing basis. It varies from plant to plant.

25 We discussed, with I believe it was the

1 CNA, backfits, and we have had typically more backfits  
2 to our older stations than we have had to our "B"  
3 stations.

4 So it varies a bit from station to  
5 station.

6 [3:00 p.m.]

7 Q. All right. So while you could try to  
8 control changes during construction, for example, as  
9 you say you were going to try -- you will be  
10 successful, or at least you said to ONCI you would be  
11 successful in doing, there are inevitably going to be  
12 changes at the existing plants and presumably that  
13 would affect the new plant as time marches on.

14 A. There will be changes for a variety  
15 of reasons, some regulatory and some improvements.

16 Q. Okay. Now, just in terms of these  
17 trends which you adopted, the 13 per cent reduction,  
18 and that ONCI accepted based on the various factors you  
19 have spoken of, Mr. Penn, and they have listed, if we  
20 were talking about major -- now I am speaking about 4  
21 by 881, but if we were talking about 4 by 881 with some  
22 significant design changes, major design changes, a  
23 separation of some of the common safety systems, or a  
24 design basis earthquake several-fold higher than the  
25 current, for example, those kinds of changes then

1 would, I take it, imply that we couldn't assume these  
2 kinds of reductions in future.

3 MR. PENN: A. Well, the cost that we  
4 speak to ONCI about, and which they accepted, was for a  
5 specific design.

6 Obviously, if you made a different  
7 assumption, and I can see no basis for your  
8 hypothetical assumption, you would come up with a  
9 different answer.

10 There was an enormous amount of  
11 information and detail behind these things. We had the  
12 whole of the Darlington design for a start off and then  
13 we had extensive other design details and analysis.

14 The answer to your question is yes, but I  
15 think it is a totally specious question, if you will  
16 excuse me.

17 Q. I'll excuse you.

18 ONCI didn't evaluate these kinds of  
19 technical questions about what will be the requirements  
20 imposed on future plants out in the future. They  
21 didn't purport to examine that; they were just looking  
22 at the costing of the plant as you envisaged it; fair  
23 enough?

24 A. They examined the nature of the  
25 detail of, for example, a vacuum building that I

1 mentioned. They reviewed the nature of the shared  
2 fueling machine situation.

3 They could hardly review the cost of a  
4 project without knowing what it is that we are costing.

5 Q. They didn't review the acceptability  
6 of the DBE you used in designing Darlington. That's  
7 way beyond their mandate?

8 A. I'm sorry, I didn't hear what it was  
9 that they didn't --

10 Q. ONCI didn't question the assumptions,  
11 for example, what the design basis earthquake of  
12 Darlington is or whether it should be the same in  
13 future. That is a very technical safety matter they  
14 didn't look into.

15 A. Well, they knew what the ground  
16 acceleration was for Darlington, they knew what the  
17 volumes of concrete and rebar were, and they knew the  
18 nature of the seismic analysis that we were proposing  
19 for future plant.

20 I think you discredit their knowledge.

21 Q. Are you suggesting then that ONCI in  
22 this two-and-a-half months not only reviewed your costs  
23 but actually reviewed the design basis, the various  
24 safety parameters and system requirements on your  
25 plant?

1           A. They reviewed it in the sense that  
2       they listened and understood what the basic principles  
3       are, and there are about four chapters in the ONCI  
4       document that describe these things, admittedly not in  
5       extreme detail but sufficient for people with that  
6       background to understand what it was we were talking  
7       about.

8           Q. My question to you, which you seemed  
9       to take some exception to was this: I wasn't asking  
10      you whether or not ONCI's -- the assumptions that were  
11      put to ONCI, and you say ONCI accepted about the shape  
12      of the plant, were right or wrong, and we will get to  
13      that later. I was just saying, if it turns out they  
14      were wrong and you were wrong, perhaps through no fault  
15      of either of you, but because of information that  
16      surfaces in the meanwhile, and we have a major redesign  
17      on our hands, that's what I am focusing on, then the 13  
18      per cent reduction, for example, quite apart from the  
19      new costs we might face because you need a new do-dad  
20      to deal with safety problem X, to the extent that we  
21      are talking about a major redesign then the economies,  
22      this 13 per cent economy, for example, may also be  
23      unobtainable because you will have lost standardization  
24      and lost changes in design, control and changes in  
25      design and so on and the various factors they listed,



1 some of that 13 per cent.

2 A. Well, again, I think your position is  
3 totally hypothetical, and obviously the answer is yes,  
4 if you make a major change in the assumption, then it's  
5 going to change the end result.

6 Q. Okay. And it will change it for two  
7 reasons, both because of the cost of that change itself  
8 and because you will lose these assumed economies due  
9 to repetition which will not occur obviously.

10 A. It changes, like, if you have a ball  
11 and it's painted red and it was blue, it's changed.

12 Q. All right. I should drop it there,  
13 it may bounce yet again.

14 A. No, I can't accept... The design was  
15 costed on a solid foundation and basis. And yes, if  
16 you want to change anything about that, you will have a  
17 change in cost.

18 Q. All right. What is your current  
19 estimate for Darlington?

20 A. I gave direct evidence on that, it's  
21 13.8 billion dollars in dollars of the year spent.

22 Q. At the time that ONCI was looking at  
23 this, if you turn to page 95 of their report at the  
24 bottom, in the middle of the bottom paragraph it says:  
25 The current Darlington cost estimate to completion is

1 11.6 billion.

2 I take it, it would have been that 11.6  
3 billion dollars or the capital component of that that  
4 they -- and that was indeed capital costs. It would  
5 have been to that that the reduction, for example, the  
6 13 per cent was applied?

7 A. I think that's reasonably fair, yes.

8 Q. Okay. And to get a feel for what  
9 that would be, rather to get a feel of what the current  
10 Darlington costs are if we were to look at the year  
11 2002 dollars, I just took 14 billion in fact and just  
12 ballparked at 5 per cent inflation rate for 10 years  
13 from today, and it got around close to 23 billion.  
14 Does that sound about right?

15 A. The projected cost of CANDU "A" for  
16 in-service in the year 2003, which was subject to a  
17 board memo and was part of the request to release the  
18 original funds, was about 19.6 billion dollars in  
19 dollars of the year.

20 Q. Well, I was just trying to compare.  
21 ONCI went on at the bottom of page 95 and on to page 96  
22 and expressed their estimate, total initial capital  
23 cost for the future station in terms of the dollars of  
24 the year 2002, hence my interest in 2002, and they  
25 estimated it at 14 billion on a system expansion basis

1 and 17 billion on a new site, on a D&A, direct and  
2 allocated basis. So I just wanted to get a sense of  
3 where that stood next to where Darlington is at now.

4 Would you agree if we just take 14  
5 billion roughly, 13.8 billion, and escalate it to 2002  
6 dollars, it come out at something over 22, close to 23  
7 billion dollars?

8 A. I would have to check that. There is  
9 a lot more than interest rate comes into this, Mr.  
10 Poch. There is construction indices and the like.

11 Q. Indeed, you have indicated earlier  
12 that that's what that 1 per cent rule of thumb is  
13 about?

14 A. In approximate terms, yes.

15 Q. All right.

16 A. On levelized unit energy cost.

17 Q. On levelized unit energy costs.

18 A. Not on capital costs.

19 Q. It will be a different escalator but  
20 it will be a positive escalator, I take it.

21 A. Yes.

22 Q. So, in fact, if I just take a 5 per  
23 cent inflation rate and escalate the 14 billion to 2002  
24 dollars, I am underestimating what you would estimate  
25 for 2002 dollars, 2002 in-service would come to? --

1                   A. I find this difficult to comment  
2                   because it's not the way that we would go about it.  
3                   The way we would do it would be knowing the profile of  
4                   the cash flow, and knowing the indices provided by our  
5                   economics division, that's how we would do it. And we  
6                   have computer programs that do this as a matter of  
7                   fact. We don't rely on back-of-the-envelope  
8                   calculations.

9                   Q. All right. You referred a moment ago  
10                  to a figure, was it 19.6 billion?

11                  A. 19.6 billion.

12                  Q. That number is a 2002 or 2003 number?

13                  A. 2003, yes.

14                  Q. When did you arrive at that number?

15                  A. In the spring of 1990, before we went  
16                  to the Board of Directors for release of funds for the  
17                  definition phase of CANDU "A".

18                  Q. All right. So, even in the spring of  
19                  '90, a few short months after the ONCI report, you were  
20                  estimating numbers 19.6 as compared to ONCI's estimates  
21                  of 17 billion for new -- I am sorry, 17 billion is  
22                  direct and allocated. 14 billion on an existing site  
23                  and presumably higher on a new site; right?

24                  A. Well, I don't know. I can't vouch  
25                  for the ONCI Inquiry Panel's number. I don't know for

1        what purpose they were going to use that. And they  
2        certainly didn't have access, in my knowledge, to the  
3        cash flow. So I really don't know how that number was  
4        arrived at.

5                    Q. Okay. So just looking at that number  
6        that ONCI did estimate, your estimation, at least your  
7        estimation was in 1991 that that was an underestimate  
8        by \$5.6 billion?

9                    A. I don't know whether the two sets of  
10       numbers were on the same definition.

11                   What I am telling you is that knowing the  
12       cash flow, knowing the current cost of major equipment,  
13       knowing the labour rates, knowing the construction  
14       indices, and knowing the in-service dates, that Ontario  
15       Hydro calculates what is the dollars of the year spent  
16       for any project. And I don't know whether it's  
17       reasonable to compare these two sets of numbers.

18                   Q. Fine. By the way, you have referred  
19       to numbers that AECL provided and you indicated there  
20       is some confidentiality, so you have prefer not to  
21       disclose them. But I gathered from the  
22       cross-examination --

23                   THE CHAIRMAN: When did he do that? I  
24       don't remember him doing that. Maybe has done it  
25       before, but I didn't hear him do it today.



1 MR. D. POCH: Q. Have I got that right,  
2 Mr. Penn?

3 MR. PENN: A. Some of the costs that  
4 Hydro reviewed were commercially restricted and those  
5 costs, Mr. Chairman, were what is called the overnight  
6 construction costs.

7 THE CHAIRMAN: I understand your  
8 evidence. You took what you got from these various  
9 vendors, which you referred to as overnight costs, you  
10 married them to your owner's costs and you came up with  
11 a figure, the figure is a composite figure  
12 incorporating both items; is that right?

13 MR. PENN: That's correct, sir.

14 THE CHAIRMAN: But if you were asked to  
15 break down that figure as between owner's costs and  
16 overnight costs you might have some difficulty, you say  
17 now, with confidentiality; is that correct?

18 MR. PENN: That's correct.

19 MR. D. POCH: Q. So what you are saying  
20 is those overnight costs are the ones where there is  
21 some confidentiality?

22 MR. PENN: A. Yes.

23 Q. I understood that.

24 But I took it from Mr. Heintzman, the  
25 tenor of Mr. Heintzman's cross, tell me if I am right

1 or wrong, that you, your adjustments to their number  
2 gets you to a place different than they feel is an  
3 appropriate expression of the cost of their options.  
4 They believe the cost is lower than you have expressed  
5 it.

6 MR. B. CAMPBELL: Well, Mr. Chairman, we  
7 can all read the entrails of Mr. Heintzman's  
8 cross-examination, but in my submission, given that  
9 AECL is a party to this hearing, if they have a problem  
10 with Ontario Hydro's view of this, it's for them to  
11 answer questions about that, not for us to answer  
12 questions about that.

13 MR. D. POCH: That's fair, Mr. Chairman,  
14 I don't need to pursue that. I could really come at  
15 this another way.

16 Q. Mr. Penn, in obtaining the quote from  
17 AECL, which you have indicated you are relying on with  
18 adjustment for this Board, has AECL offered to  
19 guarantee that price or give you any compensation for  
20 performance that varies from predicted?

21 MR. PENN: A. No, they haven't offered  
22 any compensation, but they have indicated that the  
23 costs they provided to us are based upon current  
24 tendered costs and negotiated costs with the Korean  
25 Electric Power Authority.

1 Q. Do you take that as they would be  
2 prepared to guarantee those costs?

3 A. I am sure when the time came to award  
4 a contract, then some form of negotiation would be  
5 made.

6 Q. You don't have an option at that  
7 price, if you will, right now?

8 A. No.

9 Q. All right. Okay. Let's move on to  
10 OM&A.

11 I was just looking again at the ONCI  
12 comments at page 97, they note the favourable  
13 comparison of OM&A to U.S. experience, but they note  
14 you have limited experience. And they go on to  
15 observe:

16 The panel believes therefore that  
17 there is some added uncertainty in OM&A  
18 costs during the latter half of station  
19 life. Maintenance requirements may  
20 increase due to aging of equipment, and  
21 the panel believes that Hydro should  
22 assess this component of cost on a  
23 continuing basis as more experience has  
24 accrued.

25 Are you in fact doing so?

1 MR. DALY: A. Yes, we do that on a  
2 continuing basis.

3 Q. And you have already - I don't want  
4 to repeat all the evidence - you have already given  
5 evidence that your OM&A costs are going up, have gone  
6 up, rather.

7 A. Yes. Mr. Penn gave that evidence.

8 Q. And you have initiated some special  
9 programs which you have referred to, the special hiring  
10 program and the nuclear life assurance program, do you  
11 have any indication of what the costs of those programs  
12 are, Mr. Daly?

13 A. Well, the nuclear plants life  
14 assurance program is a fairly low cost program, because  
15 as we discussed yesterday, it's mainly an overview type  
16 program that is looking at whether the other programs  
17 are appropriately funded. So that in itself is, you  
18 know, the order of a few million. It's a small cost,  
19 the program itself.

20 The nuclear hiring program I couldn't  
21 break out separately right now. I think the best  
22 indication of that program would be the chart Mr. Penn  
23 showed in his direct evidence, which shows the increase  
24 in OM&A starting at about 1988.

25 So I think if you go back to that chart

1 in the direct evidence, that's the best indication. A  
2 large amount of that was for the additional hiring.  
3 [3:20 p.m.]

4 Q. Now, ONCI goes on to observe in the  
5 second paragraph, paragraph 2 on page 98, top, that  
6 there is, of course, a relationship between OM&A which  
7 they observe is to some extent most -- actually, they  
8 say:

9 Most of the OM&A annual costs are  
10 fixed and do not vary with the amount of  
11 energy produced.

12 So they make the obvious connection that -- so if your  
13 performance goes down then the OM&A per unit per  
14 kilowatthour must go up. I take it that follows as a  
15 matter of logic?

16 A. Yes.

17 Q. And you would agree that most of the  
18 OM&A is fixed; it is not variable with the capacity  
19 factor?

20 A. Well, for a given staff level most of  
21 it is fixed, yes.

22 Q. All right. So to the extent you  
23 experience lower performance, OM&A in the LUEC, which  
24 is a cents per kilowatthour expression of cost or an  
25 avoided cost for that matter, should be moved up if we



1 believe that your performance will be lower?

2 A. Yes. I think I have already  
3 indicated a couple of interrogatories which show the  
4 variation of LUEC with capability factor, and OM&A  
5 would be one contributor to that. Incidentally, the  
6 part of Mr. Penn's direct evidence I was referring to  
7 was the chart on page 70.

8 Q. Yes. And I recall the evidence that  
9 in the forward-looking period where there is an  
10 uncertainty range you are actually assuming that you  
11 will be towards the upper end of that uncertainty range  
12 for purposes of costing?

13 MR. PENN: A. Yes. I testified that we  
14 assumed in the final curve of that particular direct  
15 evidence, which is page 73, that we adopted the upper  
16 forecast level of OM&A shown on page 70 for the years  
17 1992 through to 2014.

18 Q. So it is rising in absolute terms, if  
19 you will, and if we express this on an energy basis it  
20 also would rise to the extent performance falls in  
21 addition just because of this --

22 A. It is rising in dollars per kilowatt  
23 of 1 per cent of the value per year between that period  
24 of time I mentioned, 1992 to 2014, so that in cents per  
25 kilowatthour it would also rise unless, and as Hydro

1 expects - I expect - our capacity factors improve with  
2 time. We therefore generate more kilowatthours from  
3 the capacity that we have than we are doing.

4 Q. All right. And just for completeness  
5 before turning to total station cost a comment on  
6 fueling costs, and I take it that they recognize the  
7 uncertainty in paragraph 4 in respect of permanent  
8 disposal of used fuel but note that it has not a great  
9 effect on LUEC because of this discounting effect we  
10 spoke of earlier and because of the percentage it  
11 represents of total costs. Is that fair, Mr. Penn?

12 A. Yes. And they note that the time  
13 frame extends well beyond the middle of the next  
14 century.

15 Q. Now, that process for the settling of  
16 what indeed will happen to waste, to the high level  
17 waste, if anything, is ongoing? The Federal  
18 Environmental Assessment Review process is where that  
19 discussion is taking place?

20 A. Yes. Mr. Johansen testified on that  
21 matter.

22 Q. Mr. Johansen, you haven't filed an  
23 environmental assessment document before this Board  
24 pertaining to that aspect of nuclear?

25 MR. JOHANSEN: A. No, that's right.

1 Q. And, Mr. Johansen, you would agree  
2 that that is quite an undertaking itself, an  
3 environmental assessment of that aspect of nuclear,  
4 because of the time line and uncertainties inherent?

5 A. Certainly.

6 Q. And ONCI accepted, Mr. Penn, your  
7 fuel acquisition costs, so I take it in your fuel  
8 acquisition costs you don't include anything for mine  
9 and mill remediation apart from whatever was originally  
10 negotiated by your suppliers, I suppose, in their price  
11 to pay for that?

12 MR. PENN: A. I am not an expert in  
13 this. Mr. Doug Smith, who I think was on Panel 8, of  
14 course is, and I have a feeling, subject to check, that  
15 under the contract with Rio Algom that there is some  
16 assistance in mine closing.

17 Q. When the time comes?

18 A. Yes.

19 Q. Would you agree that there could be a  
20 significant expense at that time to deal with the  
21 tailings, for example?

22 A. I'm sorry, I don't know. I don't  
23 have expertise in that area.

24 Q. Mr. Johansen, is there someone else  
25 who could help me here?

1 MR. JOHANSEN: A. I don't think from my  
2 knowledge of the collective experience on this panel  
3 that there is anyone here who is really competent to  
4 answer that.

5 Q. So the best we can say is the  
6 indication is there will be some participation by Hydro  
7 in the carrying of those costs, provision for those  
8 expenses when they arise upon the closing of the mines,  
9 but we are not able to put a price on that, at least  
10 not right now?

11 MR. PENN: A. I was just recalling from  
12 my memory that I think that there is a provision in the  
13 contract with Rio Algom, but not with other mining  
14 companies that I am aware of, for that eventuality,  
15 that in fact the mines as a solely independent and  
16 private enterprise are responsible to the regulator,  
17 and, of course, they can't operate without being  
18 licensed by the Atomic Energy Control Board.

19 Q. So what you are saying is, assuming  
20 that the Control Board tells them they must do  
21 something about the tailings, you are anticipating an  
22 expense that Hydro will face at that time as part of  
23 your arrangement for bearing some of those expenses  
24 with Rio Algom?

25 A. And I am hazy on exactly what the

1 condition was, but I think Ontario Hydro has some  
2 arrangement through the long-term contract with Rio  
3 Algom to assist in the mine closing.

4 Q. When is that expected?

5 A. Again, subject to check, I believe it  
6 is 1996 for Rio Algom. Mr. Johansen, is that correct?

7 Q. And you are not familiar with the  
8 contract terms for the future suppliers, I take it, in  
9 any detail?

10 A. No, I am not, no.

11 Q. Now, in looking at Total Costs, if  
12 you look at the fifth paragraph on page 100 of the ONCI  
13 report, the panel observes that judgment is used by  
14 Hydro to a large degree, especially in combining the  
15 various uncertainties. And they say:

16 The panel believes that the judgmental  
17 approach should be supplemented by  
18 greater use of probabilistic cost  
19 analysis methods.

20 I take it that the ONCI Panel wasn't  
21 capable with the information available to them at that  
22 time to do such probabilistic cost estimates  
23 themselves? I haven't missed that somewhere, have I,  
24 Mr. Penn?

25 A. Well, the only probabilistic cost



1 analysis that I am familiar with is one in order to  
2 estimate the contingencies on capital costs, and, as  
3 you know, I have given evidence on that subject on a  
4 number of occasions. I am not quite sure what else the  
5 panel would have in mind.

6 Q. I took it from the paragraph that  
7 they were talking about the fact that each of the  
8 various estimates you provide has some uncertainty  
9 associated with it, and, therefore, we could both  
10 assign probabilities pertaining to that uncertainty,  
11 and in the combination of those uncertainties there  
12 would be various methodologies, probabilistic methods  
13 to combine uncertainties, to combine the different  
14 probabilities.

15 A. Well, that is certainly an  
16 interpretation.

17 Q. All right.

18 A. I think the combination of all these  
19 things is a subject that our system planning division  
20 deals with.

21 Q. I take it, then, just to finish off  
22 here you haven't done such? The analysis, my  
23 interpretation of the ONCI request or suggestion, you  
24 haven't done that to date?

25 A. What I have done, or my group has

1 done, is developed probabilistic estimating methods for  
2 contingencies on capital cost. That has been what I  
3 have done.

4 MR. D. POCH: Mr. Chairman, this is a  
5 convenient point for a break.

6 THE CHAIRMAN: Yes. We will adjourn for  
7 15 minutes.

8 THE REGISTRAR: Please come to order.  
9 This hearing will take a 15-minute recess.

10 ---Recess at 3:33 p.m.

11 ---On resuming at 3:53 p.m.

12 THE REGISTRAR: Please come to order.  
13 This hearing is again in session. Be seated, please.

14 THE CHAIRMAN: Mr. Poch?

15 MR. D. POCH: Thank you, Mr. Chairman.

16 Q. Mr. Penn, could you turn up Exhibit  
17 533, which was an exhibit Mr. Heintzman filed,  
18 entitled: Projected Costs of Generating Electricity.  
19 It is the OECD. When you get it, turn to page 66.

20 66. It is the only page I will be  
21 looking at, and just briefly.

22 MR. PENN: A. Yes, I have that.

23 Q. Mr. Penn, I am really just looking at  
24 three figures.

25 On table 1 and page 66 for Central

1 Canada, construction time in years, it says six for  
2 nuclear and seven for coal. Does that accord with your  
3 understanding, that you can build a nuclear plant  
4 faster than a coal plant?

5 A. No, it doesn't accord with my  
6 understanding. The six is correct; it is the 72 months  
7 for first unit in-service of a four-unit station. I  
8 don't know where the seven comes from.

9 Q. All right. For the load factor they  
10 took 80 per cent. I take it load factor would be most  
11 analogous, Mr. Daly, to capacity factor as opposed to  
12 capability?

13 MR. DALY: A. Yes.

14 Q. So if they were assuming an 80 per  
15 cent capacity factor, then that is like assuming an 82  
16 per cent or so capability factor?

17 A. That would be my understanding of it,  
18 yes.

19 Q. Thank you. I think, Mr. Penn, it was  
20 you who responded to a question of Mr. Heintzman's  
21 wherein you indicated that the OEB annually reviews  
22 your costs. Do you recall that comment? Sorry, I  
23 don't have a page reference.

24 MR. PENN: A. The OEB annually reviews  
25 OM&A costs of the corporation and depreciation costs of

1 fixed assets and provisions for things like removal of  
2 pressure tubes and used fuel and decommissioning of  
3 fossil and nuclear plant that -- and the like, yes.

4 Q. Just so the record is clear, though,  
5 the OEB's annual review of Hydro costs covers all  
6 current costs of the corporation, not necessarily all  
7 in every year in detail, but it is intended to be a  
8 broad review of all corporate costs, not just nuclear?

9 A. Yes.

10 Q. All right. And it focuses on current  
11 costs; that is, the costs that affect the rate year  
12 next?

13 A. Yes. For example, the OEB hearing  
14 this year will focus on the rate increase that Hydro  
15 had just proposed last week for 1993.

16 Q. And the entire hearing covering all  
17 aspects typically lasts about 20 or 25 days of hearing  
18 time?

19 A. Yes, it does.

20 Q. So you didn't mean to suggest that  
21 there is some full-blown inquiry into future nuclear  
22 costs that occurs at the OEB?

23 A. No, what I meant to imply is that  
24 things like the large scale fuel channel replacement,  
25 used fuel, decommissioning, in particular my

1 knowledge - as you know, you and I have met on a number  
2 of occasions - in detail on an annual basis, those  
3 subjects.

4 Q. We might spend a day or something on  
5 all of that?

6 A. That is typical, yes.

7 Q. Mr. Daly, I wanted to talk to you  
8 about the distinction between capacity factor and  
9 capability factor, and you did speak to this in the  
10 transcript at page 21139 at line 16, and you said:

11 Unlike capacity factor, capability  
12 factor considers only production  
13 constraints that are internal to a unit.  
14 Capability factor is, therefore, a better  
15 measure of unit performance since  
16 transmission limitations and load  
17 constraints are not included.

18 And you go on. On the next page at line 7 you say:

19 In the late 1970s and early 80s  
20 inadequate transmission capacity locked  
21 in a significant amount of energy at our  
22 Bruce site and resulted in capacity  
23 factors that were up to 8 per cent lower  
24 than our capability factors.

25 And earlier today you reiterated evidence I have also



1 heard earlier about typically you would expect the  
2 spread to be in the order of two percentage points?

3 MR. DALY: A. I think about 1 to 2 per  
4 cent, yes.

5 Q. When we look at the performance of a  
6 technology I take it, if our intention is to compare it  
7 to other options would you agree that we in fact should  
8 consider -- while we might look at trends in capability  
9 factor it is the capacity factor that will dictate how  
10 much economic contribution this option in fact makes;  
11 that is, these constraints you have called external are  
12 real constraints?

13 A. Yes, I think really to get the full  
14 picture you have to look at both factors. For example,  
15 as was mentioned earlier on, EDF have a very large  
16 nuclear component. About 75 per cent of France's  
17 electricity comes from nuclear power. So the French  
18 units have to manoeuvre. So, in fact, some of their  
19 capability factors are, you know, relatively low 56/60  
20 per cent, because they do use them for manoeuvring. So  
21 you wouldn't sort of look at those units and say, okay,  
22 they are performing poorly. That is the fact that that  
23 level is what their system requires.

24 Q. Yes.

25 A. So you really have to look at both

1 factors to get the total picture.

2 Q. So capability is a useful index if we  
3 want to look at sort of trends in problems you are  
4 having internal to nuclear plants, for example?

5 A. Yes, basically within the site.

6 Q. If we want to look at trends in what  
7 this option can provide or does in fact provide to the  
8 system, it would be capacity factor that would capture  
9 both the trends in capability factor as well as these  
10 other constraints that can come into play or choices as  
11 you have indicated in the case of --

12 [4:00 p.m.]

13 A. Well, I think you have to look at  
14 what the utility is using its different plants for.  
15 Some utilities may manoeuvre particular units more than  
16 others.

17 So I think you really need to fully  
18 understand the differences why the capability factors  
19 may differ from the capacity factors.

20 Q. And just on this question of  
21 manoeuvring, if in fact you did choose to run one of  
22 your plants in a manoeuvring, an intermediate mode at a  
23 lower average capacity factor by choice because that's  
24 what you felt the system needed, the LUEC would go up?

25 A. That's correct. And I have indicated

1 a couple of interrogatories to you earlier today where  
2 that sensitivity is documented.

3 Q. Right. And you indicated on page  
4 21144 at line 9, that:

5 We are also developing a probabilistic  
6 forecast model to assist in predicting  
7 nuclear unit performance. This model  
8 simulates the performance of 18 of the  
9 key systems.

10 First of all, are those the 18 systems  
11 which are listed on page 24 of Exhibit 519?

12 A. I believe so.

13 Yes, they are, Mr. Poch.

14 Q. So this is an area where you are  
15 looking at some kind of a probabilistic forecast  
16 technique, and which brings me back to the earlier  
17 point. Mr. Penn, you did indicate that there was  
18 another area where you were doing probabilistic  
19 assessment and that was with respect to contingency  
20 costs associated with the capital cost estimate?

21 MR. PENN: A. Yes, I said that we were  
22 using a probabilistic method to assess contingencies in  
23 certain areas.

24 Q. And that's the 15 per cent figure we  
25 have heard about?

1                   A. Actually, the 15 per cent figure that  
2 we adopted for the 4 by 881 is higher than what  
3 probabilistic theory would say. It would say about 13  
4 per cent.

5                   Q. And the probabilistic estimate is  
6 based on the actual overruns that you have experienced  
7 from initial estimates for your existing nuclear  
8 plants?

9                   A. It's based upon range estimates of  
10 all the major costs such as the material costs, the  
11 construction, direct and indirect, the engineering, the  
12 overhead. What you do is you estimate the range of  
13 uncertainty with each of these two groups, the range  
14 might go from, shall we say, minus 5 per cent to plus  
15 110 per cent, and you assign these based upon knowledge  
16 from data banks that we have and engineering judgment  
17 and the level of expectation of change in the future.

18                  Q. So these aren't, strictly speaking,  
19 probabilistic estimates simply driven by the data, the  
20 actual experience you have had. That's just one factor  
21 which you weigh in and come up with a range and then  
22 you combine your ranges; is that fair?

23                  A. Well, the basic assumption of the  
24 range estimates can't be derived by probabilistic  
25 theory. They are an input.

1                   What is the probabilistic basis is the  
2                   use of Monte Carlo processes or other hyperbole  
3                   functions that you just iterate several thousand times  
4                   to find out what the expected value is of all these  
5                   costs.

6                   Q. That is a technique you use for  
7                   combining different sets of uncertainties; right?

8                   A. That's right.

9                   Q. So you haven't then based this  
10                  probabilistic estimate primarily on the actual cost  
11                  overrun experience you have actually had in your  
12                  nuclear plants.

13                  A. Well, it's all part of deciding what  
14                  the range estimates might be.

15                  So, in part, you do use, you use  
16                  experience and we have data bases of experience over  
17                  many, many years and from different jurisdictions.

18                  Q. Do you have data bases of experience  
19                  that compare what you have estimated for costs of  
20                  nuclear, of your nuclear facilities in the past and  
21                  what they have actually come in at on a constant dollar  
22                  basis?

23                  A. We have published on many occasions,  
24                  and, in fact, one thing that ONCI asked us was a  
25                  comparison of the estimates and actual costs.



1 Q. Can you tell me how you compare an  
2 overall basis from your initial estimates to your final  
3 costs for your nuclear plants then?

4 A. I am sure we have an interrogatory on  
5 that subject somewhere.

6 Q. I am sure we do, too.

7 A. It's an interrogatory numbered  
8 9.7.62 - I am sure it not the only one on this  
9 subject - actually submitted by your own organization.

10 Q. We will come to that one. I  
11 understand the problem with that is that you weren't  
12 able to provide the estimate and the actual on a  
13 comparable dollar basis.

14 THE REGISTRAR: That interrogatory has  
15 been entered, Mr. Chairman, as .44.

16 THE CHAIRMAN: Thank you.

17 MR. PENN: Well, personally I don't see  
18 anything wrong with it. There are costs for Pickering,  
19 there are costs for Bruce "B", there are costs for  
20 Bruce "A".

21 MR. D. POCH: Well, Mr. Chairman, this  
22 appears in the second volume of our materials at page  
23 80.

24 THE REGISTRAR: I apologize, that has not  
25 been entered. It's .74.

1 ---EXHIBIT NO. 520.74: Interrogatory No. 9.7.62.

2 MR. D. POCH: Q. I took it from the  
3 revision, and indeed we followed up on this and we were  
4 going to come to this later, the revision to page 1  
5 which follows at page 81 in our exhibit indicates that  
6 the estimates you had given were in dollars of the year  
7 spent. And so because, of course, you ended up  
8 spending the dollars in different years we weren't able  
9 to do a one-to-one comparison.

10 But, Mr. Penn, just stopping there for a  
11 minute. The 1978 released estimate for Darlington is  
12 under \$4 billion. We have heard it expressed a number  
13 of ways today and other days anywhere from 13.8 to --  
14 13.8 I think was your evidence today. Certainly that's  
15 a healthy excess of 15 per cent.

16 Can I take it from that that the --

17 THE CHAIRMAN: Wait a minute. I think  
18 Mr. Penn is trying to find something.

19 MR. PENN: Yes, the 1978 release estimate  
20 of \$3.95 million in dollars of the year spent, it says,  
21 was for an expected in-service of 1989.

22 There were, of course, and I refer to  
23 Exhibit 539, a conceptual estimate in 1973 assuming the  
24 station would be fully in-service by 1984. There was  
25 another conceptual estimate in 1975 assuming the

1 station would be fully in-service by 1986, and so on.

2 And of course the delays that we spoke of  
3 with Mr. Heintzman, I believe it was, of some three  
4 years, planned delays for Units 1 and 2 and,  
5 four-and-a-half years for each of Units 3 and 4, meant  
6 that these in-service dates couldn't possibly be  
7 attained. And therefore, the relevance of a release  
8 estimate in the mid-to-late 70s really doesn't bear a  
9 relation to what has happened in reality.

10 MR. D. POCH: Q. That's precisely why we  
11 asked you, and we will get back to the point of whether  
12 it bears a relationship to what happened in reality,  
13 my understanding was it's precisely what happened in  
14 reality, but leaving that aside, it's precisely why we  
15 asked you to provide these original estimates in  
16 constant dollars so we could try to separate out what  
17 the effects are due to different dollars and interest.

18 I took it from your answer, and my  
19 correspondence which follows with Ontario Hydro, you  
20 simply can't do that. At page 85 I wrote, page 83 I  
21 got a reply at page 84 and page 85 Interrogatory 9.7.75  
22 supplementary.

23 I think we should give it a number too.

24 THE REGISTRAR: That will be .75.

25 ---EXHIBIT NO. 520.75: Interrogatory No. 9.7.75.

1                   MR. D. POCH: Q. At note 1 it says  
2 requested data of historical nature. Attempts to  
3 escalate original estimates in terms of constant  
4 dollars would not be reliable since escalation factors  
5 for nuclear power plants specific to the construction  
6 costs, composite indices, were not forecasted for  
7 periods before '81.

8                   So, Mr. Penn, I guess I am having  
9 difficulty understanding how you have done a  
10 probabilistic estimate of contingencies if you aren't  
11 even able to separate out how much the cost overrun at  
12 Darlington was due to costs of delay as opposed to  
13 these various other factors. Can I take it that --

14                  MR. PENN: A. I am not quite sure I  
15 follow your logic here. As I gave testimony the other  
16 day, and in fact, Exhibit 539 it's quite clear that the  
17 total schedule delay on Darlington has resulted in \$3.3  
18 billion increased expenditure--

19                  Q. Okay.

20                  A. --which is mainly interest.

21                  We also know that there were financial  
22 policy changes in about 1982 with regard to the  
23 percentage of depreciation of the total expenditure as  
24 the four units were built. And that's also explained  
25 in appendix 5.2, on the last page of Exhibit 539.

1                   We have also broken out what the increase  
2       in costs were due to estimate changes mainly due to the  
3       complexity of increased mechanical and electrical work  
4       at Darlington, and further, to scope changes mainly due  
5       to increases in regulatory and safety related changes.

6                   Q.   What percentages did those categories  
7       account for?

8                   A.   Well, they are all given on appendix  
9       5-1 of 539, and estimate increase from 1981 in dollars  
10      of the year, 16 per cent, or \$1 billion, and scope  
11      changes is 14 per cent or .9 billion dollars, out of a  
12      total of 6.4 billion.

13                  Now, what we were talking about the other  
14      day was trying to answer the question, would it be  
15      possible to determine the effect on the total cost of  
16      the project had we not had planned delays. And I  
17      listed about eight things that would make that  
18      extremely difficult to do.

19                  Now, I don't see that your logic of us  
20      not being able to do that has anything to do with the  
21      voracity of estimating the costs of a future nuclear  
22      station.

23                  Q.   Well, Mr. Penn, I am just trying to  
24      get at what experience has shown us and you have now  
25      pointed me to enough information. You have just



1 agreed, I think, that 30 per cent of the increase at  
2 Darlington was due to scope and estimate changes.

3 THE CHAIRMAN: Did you say that, 30 per  
4 cent?

5 MR. D. POCH: 14 plus 16.

6 MR. PENN: I said 16 per cent for  
7 estimate and 14 per cent for scope changes, Mr.  
8 Chairman, which is 30 per cent of the increase since  
9 1981 to 1992.

10 MR. D. POCH: Q. So that is 30 per cent  
11 of the recent increase. I guess what I am trying to  
12 understand hear, Mr. Penn, is in very simple terms, you  
13 have an initial estimate of -- as of '78 your released  
14 estimate was under 4 billion. You are up to close to  
15 14 billion. You have said 13.3 plus is the interest  
16 cost of the delays. It seems to me that there is going  
17 to be a difference due to the fact that we are now  
18 talking dollars of a different year. But it seems  
19 obvious to me that there is far in excess of a 15 per  
20 cent cost overrun on Darlington in real terms.

21 A. Well, we all know that the Darlington  
22 costs are very high and we all know the reason that  
23 they are very high, and that is because of significant  
24 changes in the schedule for one reason or another.

25 We all know from the ONCI document,

1 because it's clearly spelled out, that it is important  
2 if we were to reduce the schedule and cost of any  
3 future nuclear station, that we get pre-engineering  
4 done, so we have the design available before we start  
5 building it, and we don't have any interruptions while  
6 we built it. And the cost of the future 4 by 881 is  
7 based upon that premise, amongst other things.

8 So to draw a conclusion that we don't  
9 know how to estimate the future nuclear power cost on  
10 the basis of our past experience, which has been quite  
11 different, it's like saying, if we would have stopped  
12 the building of the CN Tower when it was halfway up and  
13 delayed it for 20 years, what might it cost, and  
14 therefore you can't estimate its cost in the future.

15 [4:21 p.m.]

16 Q. Well, in fact --

17 THE CHAIRMAN: I just want to back up for  
18 just a minute. I am looking at Exhibit 539, appendix  
19 5.1.

20 MR. PENN: Yes.

21 THE CHAIRMAN: It is a diagram, and the  
22 diagram seems to say that the historical cost increase  
23 in Darlington due to an increase of the actual cost  
24 over the estimated cost or the increase in the  
25 estimated cost, perhaps that's a better way of putting

1 it, is 16 per cent or \$1 billion; is that right?

2 MR. PENN: Yes, sir.

3 THE CHAIRMAN: Okay. All right.

4 MR. D. POCH: Q. And, Mr. Penn, in  
5 addition, there have been scope changes?

6 MR. PENN: A. Yes, there have because of  
7 the very long period of time over which Darlington was  
8 built and principally because of regulatory change  
9 during that time.

10 Q. All right. So say in the 10 years,  
11 11 years covered by this analysis the scope changes, as  
12 you say, principally due to regulatory changes just in  
13 that 11 years amounted to 14 per cent. That is what  
14 that says; correct?

15 A. That is what it says, yes, whereas  
16 the new four by 881 would be built in a shorter time  
17 than that.

18 Q. You forecast it would be built in a  
19 shorter time frame?

20 A. We had planned that it would be.

21 Q. But you don't control the factors, do  
22 you, Mr. Penn. I guess it is obvious, it is trite.

23 A. It is obvious. If in fact there are  
24 external influences that change the schedule, you are  
25 quite right.

1 Q. And your real life experience has  
2 been that there are such influences?

3 A. Well, not always. Bruce "B", for  
4 example, was built without any delay whatsoever, and  
5 its cost is in constant dollars per kilowatt one of the  
6 lowest costs that we have ever had.

7 THE CHAIRMAN: Again, sorry to interrupt.  
8 Do you have anywhere in the material an analysis of  
9 that 14 per cent, \$.9 billion scope changes?

10 MR. PENN: You mean a breakdown, sir?

11 THE CHAIRMAN: Well, a breakdown or  
12 description of it?

13 MR. PENN: No, I don't have it with me,  
14 sir.

15 THE CHAIRMAN: But you say it is mostly  
16 regulatory changes? Is that what I heard you say?

17 MR. PENN: It is listed on the next page,  
18 5.2, under Scope:

19 This component primarily reflects  
20 increases due to regulatory and  
21 safety-related changes.

22 One example of that was in the  
23 verification of the software for the shutdown systems,  
24 which are computerized. There was a considerable  
25 increase in the period of time necessary to verify that

1 software due to scope changes during the project.

2 MR. D. POCH: Q. Mr. Penn, you just gave  
3 me another example. You said Bruce "B" was a different  
4 experience and you came in on schedule or better;  
5 right?

6 MR. PENN: A. Yes.

7 Q. But, in fact, Bruce "B" is the very  
8 station that was kept from contributing to the system  
9 by what you have categorized as an external problem:  
10 unavailability of transmission, correct, the locked-in  
11 power problem?

12 A. Well, the locked-in power problem was  
13 associated with the total Bruce complex. I don't know  
14 if it was associated just with Bruce "B".

15 Q. If you didn't have Bruce "B" you  
16 wouldn't have locked-in power from Bruce "A". You had  
17 enough transmission for Bruce "A", didn't you.

18 A. Well, you are quite right, but I  
19 thought we were talking about capital costs earlier on.  
20 I didn't think we were talking about--

21 Q. Fair enough.

22 A. --subsequential operating  
23 difficulties.

24 Q. Fair enough. But that is another  
25 kind of factor outside your control, and you



1 experienced a factor outside your control that changed  
2 the cost effectiveness, if you will, forecast for Bruce  
3 "B"?

4 These are the realities of the world you  
5 operate in, are they not?

6 A. Well, they are, but I can give you  
7 another example.

8 Pickering "A", for example, was built in  
9 the shortest time of any of our stations, nuclear  
10 stations, and that didn't suffer from an external  
11 problem.

12 Yes, things do happen, but when we are  
13 estimating for the future it is impossible to make an  
14 assumption of what might or might not happen. You have  
15 to make the assumption that the time taken to design  
16 and build the plant is what is reasonably expected, not  
17 intruded upon by some external influence that you can't  
18 define.

19 It is like saying, well, maybe in 1999 we  
20 may hit 20 odd per cent interest rates again. Well,  
21 there is no way of deciding that today.

22 Q. Mr. Penn, wouldn't you agree --

23 A. And you can't estimate for that sort  
24 of thing.

25 Q. Right. And wouldn't one estimate of

1       that be the average experience you have actually had?  
2       Admittedly, not a large sample. The average experience  
3       you have had. In some projects you have faced these  
4       kinds of --

5                   A. Well, we think the contingencies that  
6       we apply on these projects cover reasonably expected  
7       circumstances.

8                   Q. And indeed, if we look at Exhibit  
9       539, and this is from Mr. McCredie, project manager,  
10      Darlington GS, bottom of the first page of text, of the  
11      history summary--

12                  A. Yes.

13                  Q. --he in fact cites examples such as  
14      the cost of CN Tower which increased by 150 per cent  
15      during a three-year construction period and the cost of  
16      SkyDome which climbed by about 300 per cent over four  
17      years.

18                  Mr. Penn, isn't it your experience that  
19      on these kinds of megaprojects those kinds of cost  
20      overruns are not that unusual? That is exactly what  
21      Mr. McCredie is saying?

22                  A. Well, it certainly didn't happen on  
23      Bruce "B" and Pickering "A", and I think that Mr.  
24      McCredie, although we should ask him perhaps, but I  
25      think Mr. McCredie in making those comparisons was

1       trying to put in the cost increase of Darlington from  
2       the 1981 definitive estimate, which even that was based  
3       on the assumption that the project completion would be  
4       in 1988, that the increase since then was significantly  
5       less than the increase in the CN Tower and SkyDome  
6       costs. I think that was the only reason he put it  
7       there, to put some context on it - not as an excuse,  
8       but just to put some context there.

9               DR. CONNELL: If I might make a  
10       suggestion which might help to clarify it, it may  
11       already be in evidence, but if we could see an index of  
12       construction costs over about a 30 year span from 1960  
13       to 1990 I think that would help us assess that factor,  
14       perhaps along with a consumer and price index?

15              MR. PENN: Certainly, we can do that.  
16       Construction indices and CPI over the period of time?

17              DR. CONNELL: Yes. I think that would  
18       help to show the pronounced bulge there was that  
19       started about '86 and continued through until about  
20       1990. It would be good to get that perspective.

21              MR. D. POCH: Dr. Connell, I can help you  
22       somewhat. I think we will be coming to this, and there  
23       are some cost escalators historical at page 67 of our  
24       Volume 1 of the background materials provided by Hydro  
25       and some --

1 THE CHAIRMAN: What page? Sorry.

2 MR. D. POCH: Page 67 of Exhibit 577.

3 And there is Hydro's nuclear index and the GDP  
4 deflators have been put on one page with appropriate  
5 sources and notes made on page 68. I will be coming to  
6 that a little later.

7 I don't know if that is sufficient for  
8 you, Dr. Connell, or for the witness to provide further  
9 information on it.

10 DR. CONNELL: I'm not sure. It may  
11 become clear during the cross-examination that is to  
12 come. So I will just bide my time.

13 MR. D. POCH: All right, then. I am sure  
14 Mr. Penn is grateful.

15 Q. Mr. Penn, but my point is really that  
16 these delays, which have a cost component, these are in  
17 fact a fact of life as well. The risk of a delay is --  
18 if you had to do a probabilistic assessment, the odds  
19 of a delay net but at the end are greater than the odds  
20 of you coming in ahead of schedule?

21 MR. PENN: A. I don't think it is a  
22 matter of probability. It is a matter of decision. I  
23 don't know whether I should mention the word 'political  
24 decision'.

25 But certainly in Japan there has been an

1       excellent record of building plants quickly. We have  
2       built plants in the past quickly. I don't see any  
3       reason why we can't build plants in the future quickly,  
4       given that there is a will to do it.

5               And to assume that there won't be a will  
6       to do it seems to me to place an estimate on a level  
7       which loses understanding.

8               Q. Well, Mr. Penn, would you agree with  
9       my simple proposition? I don't know if you are a  
10      wagering man, but it is pretty hard for you to come in  
11      a lot faster than the schedule you predict, but it is  
12      easy to foresee lots of ways that you could be delayed,  
13      be they political, be they strikes, be they unforeseen  
14      engineering problems?

15              A. I think that the schedule that we  
16      have got for four by 881 is realistic. There is a  
17      great deal of analysis behind it. And it may be tight,  
18      but I don't think it is at all impossible.

19              Q. Okay. You are saying it may be  
20      tight, you don't think it is impossible, but in answer  
21      to my question, Mr. Penn, given that you have got a  
22      schedule which may be tight, isn't it a lot easier to  
23      foresee circumstances which would extend that schedule  
24      than circumstances which would allow you to come in  
25      ahead of that schedule?



1                   A. I think if the project has been given  
2     the authority to proceed that it has its design  
3     available so the people who are building it know what  
4     they are going to build and how and when and they have  
5     got it all planned. I don't see, short of some  
6     undefined, unplanned delay that I don't know how to  
7     evaluate -- and that is my problem, Mr. Poch, I don't  
8     know on your proposition what to add.

9                   I wouldn't have known at the start of  
10    Darlington to have added three years to two units and  
11    4 1/2 to another two. How could I have possibly  
12    decided that?

13                  Q. Mr. Penn, separating out the question  
14    of putting a number on it, just dealing with the  
15    symmetry or asymmetry of that risk, you would agree  
16    that the risk in terms of the time line of the project  
17    is not symmetric?

18                  A. I would agree with you that there is  
19    always risk that any major project, no matter whether  
20    it is nuclear or fossil or building a windmill or  
21    whatever, there is always some circumstance that extend  
22    the schedule and therefore the cost. And it happens in  
23    life.

24                  But when we are making comparisons of  
25    options we have to put them on a basis that has

1 defined -- clear, understood, defined basis. We can't  
2 put it on an undefined basis.

3 Q. All right. Mr. Penn, I think you  
4 understand my problem here because -- it may be very  
5 difficult to estimate, but if we have an expectation  
6 that costs will be higher, if all we were doing were  
7 comparing two large projects within Hydro we might  
8 assume, because there is little else we can do about  
9 it, that the risks are going to be in the same  
10 ballpark. So we could --

11 A. I am afraid I am having difficulty  
12 with your proposition. I don't know what else to say.  
13 I can give you two other examples, though.

14 We have retubed Pickering 3, albeit that  
15 it was extended, the outage, by turbine problems, in 23  
16 months. We said that we would retube it in 24 months.  
17 We are currently six weeks ahead of retubing Pickering  
18 unit 4 in 19 months.

19 Now, I think there are very good examples  
20 there of meeting a schedule.

21 Q. Mr. Daly, this may be a Panel 10  
22 question. Maybe you can help me.

23 It seems to me if you are looking at  
24 another option, if you are using your estimate to  
25 determine avoided cost and then we are looking at what

1 we are going to pay Mr. Shepherd for his waterfall  
2 power, he takes that risk. He signs on the dotted line  
3 and takes that risk and it will cost the Hydro system a  
4 certain amount, whereas with the nuclear option the  
5 risk -- the cost to the Hydro system is still a risk  
6 borne and an asymmetrical risk.

7 Do you agree with me, that that is the --

8 A. Well, I have an understanding, I  
9 think, of what you are talking about - at least, it's  
10 vague - but I don't have knowledge of that subject.

11 Q. All right. We will leave that for  
12 Panel 10, then.

13 Mr. Daly, turning to this question of  
14 performance projections, you said at 21146, line 16:

15 The difficulty in producing such a  
16 long-term projection is that there is  
17 little actual experience available with  
18 nuclear units of this age. We ourselves  
19 have no nuclear units over 21 years old,  
20 and there are virtually no comparable  
21 units around the world over 25 years in  
22 age. So although we examine the many  
23 variables I have listed, in the end the  
24 long-term forecasts come down to reasoned  
25 engineering judgment.

1 My question is: Once you do this  
2 analysis of I think it was 18 components and you are  
3 going to do a probabilistic assessment, are you saying  
4 then you are still inevitably going to have to apply  
5 reasoned engineering judgment as the predominant factor  
6 in making such a forecast?

7 MR. DALY: A. I don't think we would  
8 ever totally eliminate judgment, nor would we want to,  
9 especially in predicting over such a long period, you  
10 know, over the remaining 20 years of plant life or  
11 predicting new stations.

12 So I think our estimates, any future  
13 estimate is going to be based part on models and better  
14 developed models and part on our own judgment.

15 Q. I'm sorry, if I have already asked  
16 you this. That model is not available, I take it,  
17 right now. When is it expected?

18 A. We expect to have the model complete  
19 this year. The bulk of the program has been written.  
20 Essentially the history, if you like, is loaded into  
21 the program. We are still working on what you might  
22 call the future aspects of the model.

23 So we expect to get some initial results  
24 out sort of over the summer period and have it up,  
25 running as what you might call -- I guess in broad

1 terms we are, if you like, commissioning the model  
2 right now. We expect to have it in service early next  
3 year.

4 [4:40 p.m.]

5 Q. Does your model include a variable  
6 for aging?

7 A. The model is based on the 18 systems,  
8 and for each of the systems the model, in effect,  
9 constructs reliability curves. So for some systems,  
10 reliability will deteriorate with age at different  
11 rates from other systems.

12 I guess the way we look at aging is that  
13 aging itself is not a very useful concept, as we want  
14 to sort of get behind that and say, okay, what are the  
15 systems that are contributing to performance decline,  
16 what in fact is the proxy for aging, because then we  
17 can do something about it. Because we know that six  
18 years from now the stations are going to be six years  
19 older, what we want to know is what systems do we have  
20 to work on.

21 Q. But I take it that the process you  
22 use, you may do it on component by component or system  
23 by system basis --

24 THE CHAIRMAN: When you refer to systems,  
25 you mean the systems listed in 519, 24?



1 MR. DALY: That's correct, Mr. Chairman.

2 MR. D. POCH: Q. The process you are  
3 using is to take the historical experience for each of  
4 those systems, or let's call them sub systems, and you  
5 fit a line to the experience and you get an equation  
6 out of that, or you try equations and see which gives  
7 you the best fit to the data?

8 MR. DALY: A. We don't rely solely on  
9 past experience.

10 The intent of this program is to look at  
11 our past experience, our current experience, and also  
12 project into the future.

13 For example, we know that certain  
14 components will be changed at certain times and we have  
15 to take that into account.

16 So the stage we are at with the program  
17 at the moment is looking into the future and saying,  
18 okay, we are going to replace pressure tubes at such  
19 and such a time, we are going to change certain heat  
20 exchangers at such and such a time, therefore we should  
21 adjust the future reliability to account for those  
22 equipment change-outs. So that is what we are in the  
23 process of setting up.

24 Q. So what you are going to do then is  
25 take a probabilistic forecast for a given system, see

1 if it's likely to be a problem, if it is, make an  
2 assumption that you will deal with that problem and go  
3 back and change the forecast; right?

4 A. If we have a definite plan to change  
5 out a piece of equipment, then that would be one factor  
6 in the future forecast, certainly.

7 Q. So this model isn't really an attempt  
8 to look at the general trend and try to see what is  
9 happening with all of the factors, some of which you  
10 haven't seen foreseen as likely to be candidate  
11 problems.

12 A. It does address all systems within  
13 the plant. The 18 systems add up to the total reactor  
14 turbine units. So the intent is to assess all factors  
15 which can contribute to downtime.

16 Q. Do you do a regression analysis based  
17 upon past experience and then adjust it based on what  
18 you know you are going to do about certain sub systems?

19 A. We have not done the type of  
20 regression analysis, for example, that Mr. Komanoff  
21 does.

22 One of the checks we do is to extrapolate  
23 past trends over a few years and use that as one of the  
24 checks on the forecast.

25 Q. All right. In our Volume 2

materials, Exhibit 578, could you turn up page 77.

Interrogatory 9.7.90--

THE REGISTRAR: .76.

---EXHIBIT NO. 520.76: Interrogatory No. 9.7.90.

MR. D. POCH: Q. --we asked you about originally anticipated OM&A costs, and you indicated that the information wasn't available with reasonable effort, if retrievable at all. And at 9.7.84--

THE REGISTRAR: .77.

---EXHIBIT NO. 520.77: Interrogatory No. 9.7.84.

MR. D. POCH: Q. --we asked you about capital addition costs originally anticipated and got a similar response.

I guess the difficulty I am having here, Mr. Daly, and the parallel here with performance is that I am trying to draw, is that we are today in the position of receiving a great many estimates, forecasts from you, and whenever we asked for what your original forecasts were for your original plants, your existing plants so we can test against actual experience, you tell us that the data has just not been pulled together and it would be impossible or very difficult.

I guess my question is: Why do you not see any value, or sufficient value to warrant the effort, in looking at how good or bad you have

1 forecasted in the past?

2 MR. DALY: A. Well, certainly in the  
3 case of reliability material for which I am primarily  
4 responsible, we do in fact do that, and we keep a  
5 complete historical record and we do make those  
6 comparisons.

7 Q. All right. And we will come to that  
8 one then.

9 Mr. Penn, perhaps I should address that  
10 question to you then. Do you see no merit in looking  
11 at past, these past estimates to see how good or bad a  
12 forecaster you and your colleagues have been?

13 MR. PENN: A. Yes, I certainly see merit  
14 in learning from the past.

15 Q. Do you not see that one way of doing  
16 that, do you not accept the most obvious way, it would  
17 seem to me, of doing that is to look at what you  
18 estimated in the past and see how much reality differs  
19 from estimates for Hydro for nuclear plants?

20 A. I don't have any problem with the  
21 proposition, but if you look at Exhibit 520.77 that we  
22 have just been talking about, one of the things it asks  
23 is, please indicate any large scale fuel channel costs  
24 included in these earlier figures, and I'm not aware  
25 that we could possibly have had the knowledge at the

1 start of the nuclear program to come up with that  
2 value.

3 THE CHAIRMAN: I am a little confused. I  
4 thought this line of examination was dealing with the  
5 future capability of the plants and how that was  
6 estimated, and now we seem to be back into cost  
7 forecasts. I am not sure they are exactly related. I  
8 realize they have some relationship.

9 What Mr. Daly is trying to do is to  
10 predict the life of the plant; is that not right?

11 MR. DALY: The capability factors of the  
12 plant.

13 THE CHAIRMAN: And I wouldn't know what  
14 usefulness the accuracy of earlier cost forecasts would  
15 help you.

16 MR. D. POCH: I'm sorry, Mr. Chairman, if  
17 I implied I was connecting. I thought by use of the  
18 phrase "parallel" I was making it clear I was jumping  
19 back.

20 Mr. Daly had commented in discussing  
21 performance that he looked at past experience, and that  
22 prompted me to ask the question about why don't you  
23 look at past experience, past forecast experience in  
24 these others areas, and I didn't mean to imply that one  
25 would reflect on the other necessarily.



1 MR. DALY: I think perhaps the most  
2 difficult thing with the question was the originally  
3 anticipated, and that means going back in many cases to  
4 records which are over 20 years old.

5 Our business planning process tends to  
6 work on a 10-year cycle, so I think you have seen many  
7 comparisons where we go back 10 years. But to go back  
8 20 years where perhaps records weren't kept in as good  
9 detail as they are kept today, and there have been  
10 many, many changes over the 20 years, so it was the  
11 originally anticipated that takes the time.

12 MR. D. POCH: Q. It's a long time ago  
13 and 20 years will be a long time from now. Two years  
14 past the in-service date you are projecting.

15 Thank you, Mr. Daly.

16 There is one tie-in between these two  
17 discussions we are sort of intermingling here. You  
18 say, Mr. Daly, you agree you are still going to have to  
19 use reasoned engineering judgment, you are going to  
20 have to make predictions about certain systems and make  
21 an engineer's judgment, if you will, about what the  
22 likely life of that system is or how you think it will  
23 perform or when you think you will replace it.

24 MR. DALY: A. That's correct. This  
25 probabilistic model is in addition to our current

1 standard CES process. So in effect we will have the  
2 basic process, the CES process plus this probabilistic  
3 process to give us a check on that.

4 So, the third factor is the judgment.  
5 But certainly if you had two different models that were  
6 giving you essentially the same result, then you would  
7 certainly think twice about making a change.

8 Q. All right. And indeed if we want to  
9 test how good you are at using your reasoned  
10 engineering judgment, your phrase, one way we could do  
11 that would be to go back to these original forecasts of  
12 capital modifications or any other forecasts you make,  
13 and see how well those forecasts have tracked, because  
14 those forecasts were based on your engineering  
15 judgment; isn't that fair?

16 A. That's fair.

17 Q. But we can't do that if we don't have  
18 the information, obviously.

19 Now, Mr. Daly, at transcript page 21153  
20 at line 7, you say:

21 Despite our preference for forecast  
22 ranges, the Demand/Supply Plan Update  
23 required us to use single point estimates  
24 for long-term nuclear performance.

25 First of all, Mr. Daly, with respect to

1 your preference for forecast ranges, that's where you,  
2 for example, for ONCI you said some 75 to 80 would be a  
3 range that would be appropriate for testing?

4 A. Yes, that type of range, that's what  
5 I was referring to.

6 Q. And so who told you that you needed  
7 to use a single point estimate? That would come from  
8 system planning?

9 A. Yes. Well, we did supply system  
10 planning with the ranges, so we supplied them with both  
11 the median and the ranges. But my understanding of the  
12 process was that in coming up with the median estimate  
13 in the Update, they had to choose particular values to  
14 reflect the media, and the values I presented in my  
15 direct evidence were those values.

16 Q. Did they choose the median or did you  
17 tell them what the median was?

18 A. They chose the median based on the  
19 information I had provided.

20 Q. All right. Now, the range you  
21 provide, you gave a range with a probability curve? Is  
22 that how it looks, sort of as we saw in Panel 1?

23 A. More typically, typically it's a  
24 median with a 10 per cent lower bound and a 90 per cent  
25 upper bound.

1                   What we are trying to do with these  
2 ranges is essentially the same as is done in load  
3 forecasting where you have an upper bound to the load  
4 forecast and a lower bound, and we feel we have just  
5 been using these ranges more rigorously in the last few  
6 years and we feel this is an appropriate way to go, so  
7 we provide them with that type of range.

8                   Q. What are your 10 and 90 per cent  
9 confidence limit numbers for that figure for the future  
10 plant?

11                  A. For a future plant?

12                  Q. Do you provide for the future plant  
13 or only for the existing system?

14                  A. Well, during ONCI where the focus was  
15 on the future plant, we provided those ranges and these  
16 were the 75 to 85 per cent as the 10 per cent to 90 per  
17 cent range for the future plant.

18                  Q. When you say 10 to 90, is that based  
19 on some statistical analysis or is that really just  
20 your judgment that you think there is an 80 per cent  
21 probability you will come somewhere between 75 and 85  
22 per cent?

23                  A. That was based largely on our  
24 experience with the "A" stations and the "B" stations  
25 and our knowledge of the types of changes that would be

1 put into a future plant.

2 Q. Despite the use of the phrase  
3 confidence interval and 80 per cent confidence limits  
4 and so on, these aren't numbers generated by a model  
5 which produces a probabilistic curve then. These were,  
6 as you say, a matter of judgment.

7 A. No, these were reflective of the  
8 ranges we were getting for our existing plants, the  
9 type of ranges we were producing for our existing  
10 plants.

11 Q. In answer to my question, then did  
12 you generate these limits with a statistical model from  
13 that data set?

14 A. Okay, this particular probabilistic  
15 model which I described in my direct evidence was not  
16 available to us at that time.

17 Q. And so that would have been a less -  
18 I don't want to use the word less rigorous - but less  
19 formalistic, non-mathematical derivation you gave to  
20 ONCI, whereas you are now saying you do a probabilistic  
21 estimate for system planning amongst other measures?

22 A. Yes, we have made more use of the  
23 forecast ranges in recent years and we are also  
24 developing this probabilistic forecasting model.

25 Q. You said you gave system planning a



1 probability range and I am just wondering, the one you  
2 have given system planning now as used in Update, was  
3 it based on some kind of a statistical model?

4 A. It was based on our experience in  
5 using the consistent energy set. Whether you would  
6 call the consistent energy set a statistical model,  
7 it's a model that produces statistics. It's not as  
8 detailed, it doesn't use the Monte Carlo techniques,  
9 for example, that Mr. Penn was referring to, so it is a  
10 model which uses some statistics.

11 Q. Is it a model which is generating a  
12 projection based on the data set that's available, the  
13 actual experience to date and the trends in that  
14 experience, or is it a model which simply aggregates  
15 whatever assumptions you feed into it about engineering  
16 assumptions?

17 A. I think the latter essentially, yes.

18 Q. Okay. Mr. Daly, you are having some  
19 problems at Darlington 1, that unit is not yet  
20 in-service, so it doesn't show up in your capability or  
21 capacity factor analyses yet, does it?

22 A. It shows up in some of the figures I  
23 show. It depends which particular analyses you are  
24 looking at.

25 For example, if we were looking at

1 analyses since first electricity, which is the type of  
2 analyses where we compare ourselves with PWR and BWR,  
3 then Darlington Units 1 and 2 have produced electricity  
4 and did show up in that analysis.

5 If you are looking at analyses since  
6 in-service, then only Unit 2 would be in the  
7 statistics.

8 Q. And so all the lack of energy, if you  
9 will, from Darlington due to the delays and the  
10 problems, that doesn't -- if we look at your average  
11 capacity factor for the system, I think you gave it, if  
12 memory serves me right, 73 per cent to date, does that  
13 sound right?

14 A. Lifetime to date?

15 Q. Lifetime to date, yes.

16 I know you have provided a number.  
17 Perhaps we should get just to be...

18 I am afraid the only number I can put my  
19 finger on is 1991 in your evidence.

20 A. I mentioned a figure of 74 per cent  
21 this morning, but that was a future projection from '92  
22 to 2014.

23 Q. Yes, at page 27 of Exhibit 519, CANDU  
24 Ontario Hydro reactor type average lifetime capacity  
25 factor 73.3.

1                   A. Right. Darlington Unit 2 would be  
2 included in that figure since it was declared  
3 in-service October 1990.

4                   Q. And it would it would be only  
5 Darlington Unit 2 availability or performance since  
6 October 1991 that would be in here?

7                   A. Since October '90.

8                   Q. October '90.

9                   A. Yes.

10                  Q. The delays we have spoken of and the  
11 problems we are having with the other units not yet  
12 in-service, none of that is reflected in this number;  
13 is it?

14                  A. That's correct. They don't show up  
15 in in-service capability factors. They show up as loss  
16 of energy, delays in in-service.

17                  MR. D. POCH: All right.

18                  Mr. Chairman, it's an appropriate place  
19 to break.

20                  THE CHAIRMAN: I am afraid we are going  
21 to have to stop. We will adjourn until tomorrow  
22 morning at ten o'clock.

23                  MR. BULLOCK: A word, Mr. Chairman,  
24 please?

25                  THE CHAIRMAN: I hope it's a short word

1 because I have got to get going.

2 MR. BULLOCK: It's a very short one, sir.

3 With your leave, sir, I will be retiring  
4 at this time and Mr. Lu Chan of Borden and Elliot will  
5 be assuming the role of counsel for CNA.

6 THE CHAIRMAN: Thank you, Mr. Bullock.

7 We are adjourned until tomorrow morning  
8 at 10:00.

9 THE REGISTRAR: Please come to order.

10 This hearing will adjourn until tomorrow morning at ten  
11 o'clock.

12 ---Whereupon the hearing was adjourned at 5:00 p.m. to  
13 be resumed on Wednesday, April 8, 1992, at 10:00  
14 a.m.

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E R R A T A  
and  
C H A N G E S

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Date: Monday, April 6th, 1992.

| <u>Page No.</u> | <u>Line No.</u> | <u>Discrepancy</u> |
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| 22537 | 23, 24 & 25 |  |
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RECORD READS: All right, but we don't have that  
planned safely yet.

RECORD SHOULD READ, Starting at line 22:

Q. All right.

A. But we don't have that plan.

Q. And it would be stored  
safely?

A. Yes, safely.

|       |    |                     |
|-------|----|---------------------|
| 22551 | 18 | sighting s/r citing |
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